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AUGUST, 1960

AGE

investigation of...

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vol. 3
no. 8

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OCT 14 1960
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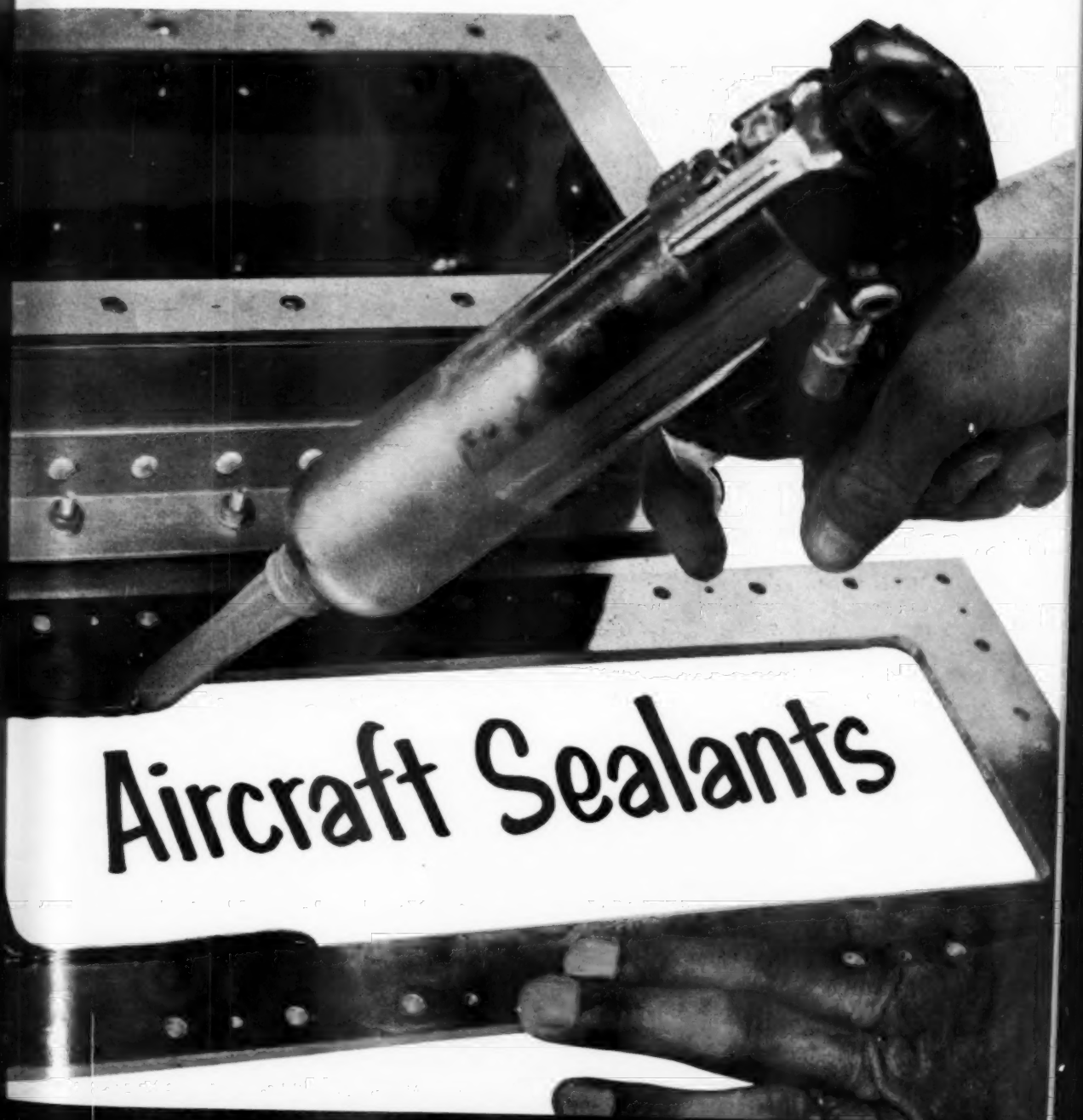
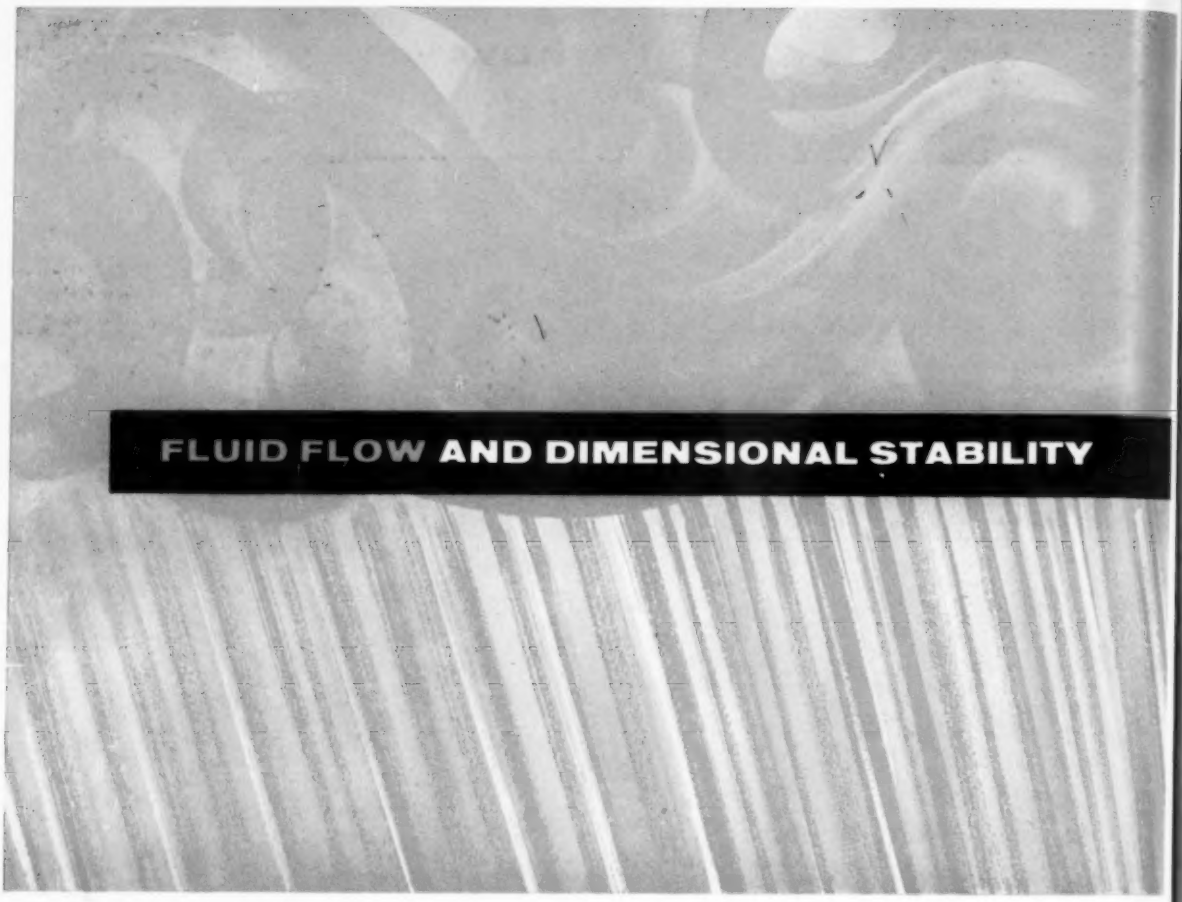


Aircraft Sealants



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1. Provides a large list of tested adhesives with unusual properties immediately available to every industry.

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You are invited to contact American Latex for a survey of your own adhesive needs and an analysis of how "specific purpose" Stabonds might cut costs, improve quality, speed production, and save labor.

Footrests Bonded Successfully

Airliner footrests exposed to roughest wear hold fast when fabricated with new Stabond C-143. Ideal for rubber-to-aluminum seals, this new modified Hycar base adhesive bonds rigid or low plasticized vinyls, natural and synthetic rubbers to themselves or to nonporous metal surfaces.

Metal Bond Withstands 500° Temperatures

Stabond EP-115 two-component epoxy base adhesive recently developed by American Latex has produced metal-to-metal bonds resistant to temperatures in the range of 450° to 500° F.

The new material is also suitable for casting purposes such as tooling, dies, match plates, prototype molds, etc.

This highly filled compound, after cure, can be machined, sanded, filed, drilled and tapped similar to a light metal alloy.

Tech Data Available

Formulations and specifications of standard Stabond adhesives developed by Freedlander Research and Development Laboratories is available in a technical information bulletin.

Organized as to principal use, type, color, coverage, shelf life, temperature limits, consistency, tack period, flammability, toxicity, etc., the bulletin is a handy reference for every adhesive user.

Copies will be sent to interested parties upon request. Contact Freedlander Laboratories or your nearest American Latex branch office.

EP-110 Cuts Fabricating Costs

Efficient and time-saving bonding methods in the fabrication of metals, glass, wood, thermosetting plastics, hard or vulcanized rubber, are made possible by Stabond EP-110, new two component adhesive developed by American Latex. Unique mixing system makes EP-110 easier to use than traditional two-component bonding agents; eliminates measuring, weighing, waste. Stabond EP-110 will cure at room temperatures or can be oven heated for rapid setting.

Freedlander Lab Develops 28 New Adhesives

Current product list of the Adhesives Division of American Latex Products Corp. numbers in excess of 150.

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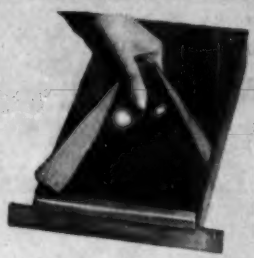

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About the Cover Photograph

This month's cover photograph spotlights the feature article on "Aircraft Sealants" which begins on page 26. The article details investigations carried out at Wright Air Development Center. Philip A. House, the author of this report is a materials engineer in the Elastomers Section, Non-Metallic Materials Division, Materials Laboratory, WADD.

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PALMERTON PUBLISHING CO., INC.

AUGUST, 1960
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Proper employment of adhesives is a paramount issue in the volume production of door skins

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News about R&A SINCE 1913 **Adhesives**

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Since all three feature excellent mechanical strength plus resistance to many solvents, to water, atmospheric conditions, and temperature changes, they are also widely used as insulating varnishes for impregnating coils and small electrical equipment.

•

TYPICAL PRODUCTION METHODS

Most companies develop their own techniques to bond stack laminates most efficiently. The three most commonly used are:

1) Coat, stamp, and stack;
2) Stamp, pre-coat, then stack;
3) Coil or stack, then vacuum impregnate.

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Huge electron accelerator magnet cores (a recent one involved 475 tons of oriented silicon steel laminations!) are being bonded with one of our non-epoxy solvent-dispersed rubber/phenolic adhesives. If you can heat-cure at pressures of 100 psi or more, write for information about BONDMASTER E379.

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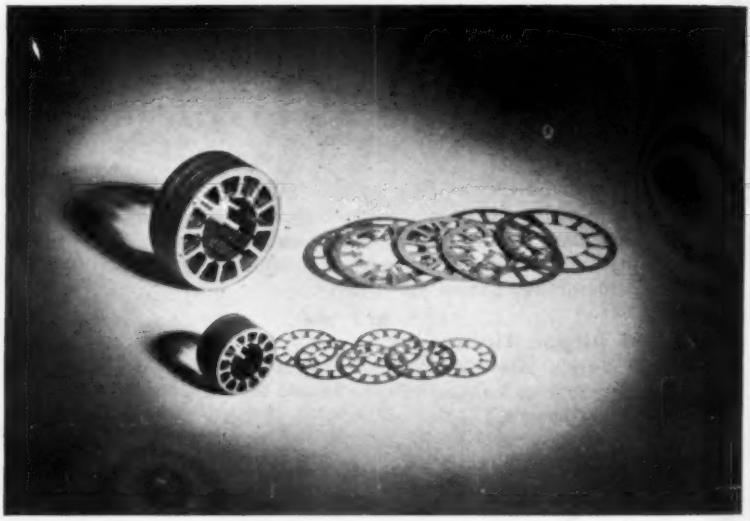

Now you can machine adhesive-bonded stack laminations of magnetic steel cores . . . machine them to tolerances as critical as you can control your equipment . . . *without fear of failures.* In addition, these laminations can now be produced without the internal stresses that have plagued the industry for so many years . . . can be made far more accurately, more uniformly, more swiftly than has ever been possible with riveted assemblies.

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Write for Technical Data Sheets detailing adhesive laydown, curing cycles, bonding methods, etc., of BONDMASTER Series "E" adhesives for the electrical industry.

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EDITORIAL

A Guest Editorial

A Theory or a Science

Adhesion scientists have generally published the results of their theoretical studies under subject headings, either stated or implied, that indicate that there is a common "theory of adhesion." To these workers, there is only one theory of adhesion, namely that molecular forces cause one material to stick to another; the numerous other factors that are concerned with the preparation and properties of bonded assemblies and the technology of adhesives are not included as part of the theory.

The meaning of the term "theory of adhesion" as generally used by some scientists and most technologists includes everything from preparation of the adherends to behavior of the bonded joint in service. No one theory will explain the behavior of all these in the wide variety of materials and systems known today. However, many are led into believing that there is a simple "theory of adhesion" when they see publications and hear talks that imply that there may be such a theory, and express their disappointment and lack of understanding of the fundamental aspects of adhesion by repeatedly stating "If we only knew why one substance sticks to another." One possible way to help get out of this mental groove is to use different words that will show clearly that the problems are complex and interrelated in many ways because of the diversity of substances and systems.

It is proposed that the term "science of adhesion" or "adhesion science" be used to show that parts of the scientific disciplines are blended into several theories to explain why things stick and stay stuck to one another in specific systems under particular conditions. The term "science of adhesion" covers all of the regular attributes of any other science, including a set of related theories and technical methods applied to a specific area of knowledge and the implied existence of a number of scholars and researchers who share an interest in training for or undertaking further explanation of this specific area.

The term "science of adhesion" is not new either in concept or precedent. The small group at a meeting of ASTM Committee D-14 on Adhesives in 1953 that initiated the Gordon Research Conferences on Adhesion had as one of their prime purposes to develop "the science of adhesion." Polymer science, plastic science, aeronautical science, and space science, are examples of derived sciences in that they consist of applicable parts of the scientific disciplines, such as physical chemistry, organic chemistry, mechanics, metrology, heat, etc.

More widespread use of the term "science of adhesion" will help to keep scientists and technologists out of the mental blind alley of "since we do not know what adhesion is, we can not . . ." We will have a broader, more open-minded attitude if we recognize that this new, incompletely developed science consists of many aspects of chemistry and physics and that many theories are needed to explain all that we observe in studies on adhesion and adhesives.

Frank W. Reinhart
Chief, Plastics Section
National Bureau of Standards

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CONSULTANT'S CORNER

By Dr. Irving Skeist

Window Blinds

Question: Enclosed is a sewn strip of our product which is used for window blinds. We have to make many thousands of these continually and sewing is expensive and slow. Could we use a quick drying adhesive? The material is in rolls from 4 to 20 inches wide and is sewn twice every four inches before being cut apart.

We would also like to know if there is a rolling machine that would apply glue every few inches. We would not want to make one if there is one already on the market.

Answer: The sample enclosed consisted of parallel sticks approximately one-eighth of an inch in diameter and woven intermittently with cotton cord.

Either cord or cloth could be bonded to the wooden sticks with adhesive. A soft vinyl acetate copolymer emulsion should perform well. It can be applied to the appropriate surface of the cord or cloth, which can then be held in contact with the wood under slight pressure for fifteen or twenty minutes, until the adhesive sets. No heat is necessary. By putting the adhesive on the cord rather than the wood, you eliminate the need for a special machine, since a conventional roll applicator will do. *Q-157*

Phenolic to Nylon

In our May issue we carried a request from an appliance manufacturer who was having difficulty fastening a small nylon window into a phenolic block used as the base of a coffee maker. Plastic Associates, Laguna Beach, Calif., informs us that they have developed a nylon "welding" process that uses both a solvent and an epoxy bonding agent to obtain a tight, hermetic joint between nylon and other materials.

Readers who would like to contribute their own experience with problems similar to those discussed in Dr. Skeist's column are invited to write to ADHESIVES AGE, *101 West 31st Street, New York 1, New York. Please refer to the code number given at the end of each question and answer group.*

CONSULTANT'S CORNER

Teflon Again

Question: We have encountered a problem where it would be desirable to bond or cement a thin section of Teflon, in the form of a diaphragm, to a heavier supporting member of Lucite or Plexiglas. We are also curious to learn if there is an adhesive available for cementing or bonding Teflon to Teflon and Teflon to brass or stainless steel. We have exhausted our local sources of adhesives and technical help and are requesting your advice and comments on these applications.

Answer: Several issues ago, the problems of bonding Teflon were discussed in this column. Once again the question is posed: "How do you bond a material that is resolutely opposed to Togetherness?"

The Carl H. Biggs Co. of Santa Monica, Cal., advises that it has epoxy adhesives which work satisfactorily on roughened Teflon surfaces.

Minnesota Mining and Mfg. Co., St. Paul, Minn., has knowhow on the treatment of Teflon with metallic sodium in liquid ammonia, to make it amenable to bonding.

A recent paper in this journal describes the use of Cobalt 60 irradiation to provide a bondable surface on Teflon.

Additional suggestions from readers would be welcome. *Q-156*

Two in One

Question: We plan to manufacture solar collector units which may reach temperatures as high as 230°F. on the plate surface in Arizona, and 214°F. in Wisconsin. Our design has been determined, and we will appreciate your suggestions and advice for bonding Mylar film to the wood frame.

We have a second bonding problem. We would like to attach metal baffles to a metal housing in a milkhouse heater without using welding.

Answer: A two-part epoxy adhesive, consisting of a liquid epoxy resin and a polyamide curing agent, is worth trying for the first job. It is cured with moderate heat.

For the second job, try a phenolic resin-nitrile rubber adhesive cured at 275°F. *Q-166*

Vinyl to Flocked Rubber Suede

Earlier this year, this column carried a question on how to laminate vinyl to flocked rubber suede. One of our readers has written in suggesting an acrylic-rubber combination which has found wide acceptance in the optical case industry. It is manufactured by the Industrial Latex Co., Wallington, N. J.

Dr. Skeist is associated with Skeist & Schwarz Laboratories, Inc., 89 Lincoln Park, Newark 2, N.J. He is the author of the recently published book, "Epoxy Resins."

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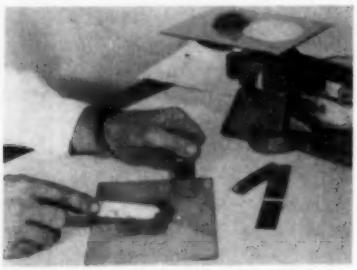

able. They are Scotch-Weld brand structural adhesives EC-1751, EC-1838, and EC-2054, applicable for high strength metal and plastic structural bonding where heat and pressure are not feasible in the bonding operation. All three adhesives are said to maintain high strength properties over a service temperature range of −67° to 160°F. Shear strengths of metal-to-metal assemblies bonded with these adhesives range from 2300 to 3200 psi at 75° F. service temperature. According to the company they have high creep resistance under constant stress, exceptional adhesion to metals and plastics, and good resistance to water, hydraulic oil and aromatic fuels. *Minnesota Mining and Manufacturing Co.* **P-344**

General Purpose Adhesive

Rez-N-Glue #244 is an oil resistant general purpose adhesive, designed for clean, strong bonding of wood, felt, cork, insulation, fabrics, leather and some synthetic rubbers, to themselves and to metals. The adhesive is light tan in color and is said to produce tough bonds that are highly resistant to heat, cold, water, oils and gasoline. The product's durable qualities improve with age and without embrittlement of the adhesive film. One gallon coats approximately 200 square feet. The adhesive comes in quart, gallon, five gallon, and 55 gallon containers. *Schwartz Chemical Co., Inc.* **P-345**

Urethane Foam Bond

Rez-N-Glue #301 is a clear, fast drying adhesive formulated for bonding urethane foams or rubber foams to themselves. According to the company, the adhesive produces a tough, flexible, nearly translucent bond with rapid rate or open time. Parts can be assembled within five minutes after coating. Maximum assembly strength is developed within one half to one hour after bonding. The adhesive is applied by brushing of the surfaces to be bonded. After three to five minutes open time the sections are pressed together to assure good contact. Rez-N-Glue #301 comes in one quart, one gallon, five gallon, and 55 gallon containers. *Schwartz Chemical Co., Inc.* **P-346**

Plastic Filling Material

Jiffy Floor, a new plastic material for filling cracks, expansion joints or shallow holes in concrete or plank floors, is not affected by temperature changes and can be applied in a few minutes. According to the manufacturer, the product is waterproof, dustless, skid-resistant and noiseless. It will not crack, crumble or peel, and requires no mixing. *The Monroe Company, Inc.* **P-347**

Household Neoprene

A neoprene adhesive for use around the house, Carboline Neoprene Adhesive F-1 gives a bond that is flexible and resilient. It is recommended by the manufacturer for tricky bonding jobs on surfaces that flex, as well as for use on rigid materials. Little or no drying time is required. Available in 3¾ ounce tubes packaged 12 to the display carton. *Carboline Co.* **P-348**

Vinyl Asbestos Adhesive

Vinyl Asbestos Brush-On Tile Adhesive is designed specifically for use in installing vinyl asbestos floor tiles. It is easily applied with an ordinary paint brush and comes in quart and gallon sizes. *Consumers Glue Co.* **P-349**

Epoxy Dipping Compound

Meta-Gel 103 is a 100 per cent solids epoxy coating compound which is said to provide for coatings in a wide range of controlled thicknesses. The catalyst system is non-ionic and is substantially unreactive below the curing temperature, making the product stable and storagable at room temperature for extended periods. The material becomes fluid when agitated and gels as agitation ceases, providing smooth, sag-free, non-drip coatings. According to the company it is particularly well suited for use as a dipping compound for coating small coils, motor fields, transformers, chokes, resistors, capacitors and similar items. *Metachem Resins Corp.* **P-350**

Epoxy Resin Repair Kit

An epoxy resin utility repair kit, the Util-Seal Kit, is designed for simple economic and rapid permanent repairs to pipe and tubing, pipe

joints, pipe fittings, tanks, and other vessels. The kit is small enough to be carried as spare gear on service trucks, and it is especially recommended by the company for minor repairs in hard-to-get-at places like gas mains. The package contains individual portions of resin, activator and fibrous reinforcer, and a collector ring and pressure relief vents for use during the "setting-up" period. *Dresser Manufacturing Division.* **P-351**

Fluorescent Adhesive

Brilliant daylight fluorescent colors are combined with rubber-saturated Flex-Stik "B" pressure-sensitive adhesive stock in Fluorescent Flex-Stik. Orange-red and orange-yellow have been combined with .004" adhesive stock. The product is moisture-resistant and is said to retain its brilliance in all kinds of weather. It is easily removable. *Kleen-Stik Products, Inc.* **P-352**

Home Plastic Mender

A new plastic glue, Duro-Plastic Mender, which repairs products made of vinyl plastic, is available for home repairs. Transparent and water-resistant, it will repair household items ranging from toys to raincoats. A chemical action similar to a weld seals punctures permanently. The glue resists gasoline and boiling water and adheres to wood, metal, leather, chinaware, rubber, paper and cloth. *Woodhill Chemical Co.*

P-353

Butyl Roof Coating

U.S. Royal Roof Coating combines rubber and aluminum and is said to extend the life of asphalt roofs as much as 15 years. It has a base of butyl synthetic rubber, and its colors are formulated with aluminum pigments that improve a roof's ability to reflect heat by 15 per cent, thus making a house cooler. In addition, the company claims, the coating is waterproof, will not chip, crack, or peel, and the colors are fade resistant. *U.S. Rubber Co.*

P-354

Epoxy Casting Compound

Hysol 15-032, a non-burning, self-extinguishing, flexible epoxy casting compound has been developed. It is a two-component, filled epoxy casting system recommended for use on transformers and other electronic and electrical parts. It is also flexible and can be used as embedding material when required, to meet thermal shock conditions. Hysol 15-032 comes in white and pastel colors. *Hysol Corp.*

P-355

Rubber Base Adhesive

Rez-N-Glue #234 is a rubber base adhesive for cementing highly plasticized vinyls to many other materials. It resists oil, gasoline, water, heat and cold, and is said to be particularly well suited for bonding vinyls-to-metals, woods, cloth and leather. Typical applications are the bonding of vinyl bathtub seals and vinyl channeling for windows. The product is an amber-colored, oil resistant synthetic rubber base glue which can be thinned with acetone or methyl ethyl ketone. It is available in one quart, one gallon, five gallon, and fifty-five gallon containers. *Schwartz Chemical Co., Inc.*

P-356

High-Temperature Cements

Two high-temperature refractory cements, Astroceram Types A and B, capable of withstanding temperatures of 4300°F. and 5000°F., respectively, are available. The cements are said by the company to be particularly suitable for use as a sealer, mortar and casting compound. Type A can be air-dried and adheres to metals readily. Type B must be fired to develop a bond and is used primarily with refractories. It exhibits very low thermal expansion, resulting in exceptional resistance to heat shock, according to the manufacturer. *Instrumentation Associates.*

P-357

Multi-Purpose Resin Adhesives

Three new viscosities, 220, 1500, and 2000 cps, have been added to the Solu-Rez series of multi-purpose polyvinyl acetate resin adhesives. The adhesives are said to offer excellent mileage because of high solids content, and to undergo no significant viscosity changes under constant agitation. The adhesive produces strong bonds on a wide range of different types of carton surfaces and, according to the company, Solu-Rez adhesives can easily be cleaned from machine parts and removed with water. *Morningstar-Paisley, Inc.*

P-358

Light Color Floor Adhesive

White S-235 is a light colored resilient flooring adhesive developed to eliminate the "black line" appearance of seams where floors are installed with dark adhesives. The product is recommended by the company for both on- and below-grade installations, and retains all of the installation characteristics of its predecessor, S-235. It can be used for the installation of sheet plastic flooring material with moisture-resistant backing, rubber tile and homogenous vinyl tile. *Armstrong Cork Co.*

P-359

High Speed Vinyl Paste

Development of a new high speed vinyl resin-based lap end paste for can labeling operations, known as Cascorez CV-704, has been announced. Among the properties claimed for the product are: three times as much coverage as vegetable types, low viscosity for easy handling, high moisture resistance with excellent non-warp properties, high solids and fast setting which eliminates corrosion "show-through" and allows greatly increased label machine speeds. Cascorez CV-704 comes in 5 and 55 gallon drums. *The Borden Chemical Co.*

P-360

Waterproof White Glue

Duro-Plastic White Glue is a waterproof all-purpose adhesive for use around the home that adheres to porous and non-porous surfaces. According to the manufacturer it will not freeze and, once applied, will not be affected by oil, water or gasoline. It will also withstand boiling water. It can be used to mend chinaware, it holds nuts and bolts tight, and is also intended for furniture and woodwork repair. *Woodhill Chemical Co.*

P-361

Insulation Glue

Dux-Sul-Glue is a general adhesive for either blanket or block form insulating materials used in a wide temperature range. Its controlled tack-range is said to make it suitable for any practical application and permit use with either brush or scraper blade. It is non-flammable and a single gallon of this rubber-dispersed adhesive covers about 200 square feet and forms a bond of all insulating materials to sheet metal. *Grant Wilson, Inc.*

P-362

Oops . . .

The June, 1960 issue of ADHESIVES AGE carried a description of four new "Scotch-weld" adhesive films produced by the Minnesota Mining & Manufacturing Co. The item stated that high bond strength in excess of "250 psi tensile strength can be obtained . . .". The figure should have been "2500 psi tensile shear strength." We regret the error.

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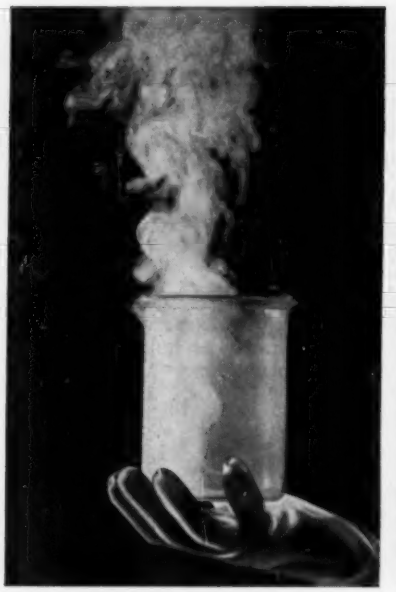

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RESISTANCE TO SUN-LIGHT AND WEATHERING

Enjay Butyl has proven its resistance to ultra-violet light, ozone, oxidation, moisture and mildew. Increases life of products such as weatherstrips, garden hose, wading pools and automotive parts.

RESISTANCE TO CHEMICALS

Enjay Butyl, because of its unique and extremely low degree of unsaturation, offers excellent resistance to corrosive chemicals. The preferred rubber for tank linings, hose, seals, gaskets and other applications where exacting chemical resistance is required.

VIVID COLORS

Enjay Butyl requires no additives for quality coloring over a wide range of hues. Famous for colorability and smooth finishes, Butyl has been successfully plastic coated for special applications.

RUBBER

PERFORMANCE

DAMPING PROPERTIES

Enjay Butyl absorbs shock and vibrational energy more completely than any other rubber. Resiliency can be varied in compounding and processing. Butyl is ideal for axle and body bumpers, motor mounts and sound-deadening applications.

IMPERMEABILITY TO GASES AND MOISTURE

Enjay Butyl is tops in impermeability to gases and moisture . . . retains air pressure 8 times better than natural rubber. Outperforms other rubbers in such application as inner tubes, jar and bottle seals, hoses and inflatable goods.

ELECTRICAL RESISTANCE

Enjay Butyl tops all vulcanizable rubbers in electrical and dielectric properties . . . in resistance to corona and ozone breakdown and water absorption. Its high dielectric strength insures against electric breakdown under normal or surge voltage. Its heat resistance permits higher current flow for a given conductor size.

The outstanding properties of Butyl Rubber create new horizons for the designer, and offer to manufacturers an opportunity to utilize the qualities of rubber in applications never before possible. The unique properties of Butyl have led to vast improvement in many existing products. Technical skills will open the way to countless new uses.

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ENJAY® BUTYL

capitol cues

THE BUSINESS OUTLOOK IS SOMEWHAT CLOUDIER than it was a month ago. Most economists still think that activity will keep on rising slowly in the second half. But even the optimists have some doubts. It's not that signs of softness are increasing. Rather, the strength that was expected hasn't quite materialized. June's sluggish business has made this point clear.

Consumer spending is still the key to the second-half trend, though even it has a rather lackluster outlook. Employment will climb only seasonally, and hours of work are not rising. So consumer incomes--and buying--will go up only moderately.

Strength elsewhere in the economy leaves a lot to be desired. Capital spending will rise slowly. (The expected 1960 gains came early.) Home-building activity will pick up, but not until late this Fall. Inventory accumulation, now falling, will turn about slowly. Government spending will rise little. If businessmen become nervous, even these gains might vanish.

Here's what a majority of economists see in the last half:
-Industrial output will increase 2% to 3% to a new record.
-Housing starts will go up 100,000, to a 1.3 million-rate.
-Auto sales will be as good as the Spring's--but no better.
-Appliance sales will rise 3% to 5%, as housing expands.
-Unemployment will jump as new workers fail to find jobs.

CREDIT WILL CONTINUE TO EASE IN COMING MONTHS, say monetary experts. But it won't be because of any new action Washington is currently planning. The Federal Reserve wants to remain neutral till a year-end trend is clear. Rather, the easing will flow from slowly lessening demands from borrowers.

-Short-term interest rates, which have been declining for much of the year, are expected to slip more by year-end.
-Long-term rates--mortgages, bonds--will fall more slowly. Mortgage lenders will be asking for smaller discounts.

WAGE HIKES IN THE SECOND HALF will average about 8½¢ to 9¢ an hour. The pattern that has held so far in 1960 will rule in the last six months. Of course, there'll be some gains much bigger, offset by smaller ones, too. Unions will be getting some additional fringe benefits, which will increase the over-all costs to employers; but the business slowing will limit these.

-Fattest increases in wages will be won in construction, which will push the nonmanufacturing figure above 10¢.
-Smaller hikes will show up in railroads--5½¢ plus--and in textiles, aircraft, airlines, and telephone companies.
In addition, there will be boosts of 10¢ or more in rubber, reflecting regular wage increases, plus cost of living extras.

SOME INCREASES IN RAIL FREIGHT RATES seem certain to result from the wage settlements recently granted. Rail profits are too thin to permit much absorption of costs. Hardest hit by any boosts will be bulk commodities--business not likely to be lost to competing carriers.

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capitol cues (cont'd)

BUSINESS ABROAD IS NOW SLOWING DOWN, just as it is in this country. But the causes of the leveling aren't always the same as those in the U.S. Europe's boom, for example is losing momentum because of lack of capacity. The labor force is fully employed. Tight money is hampering expansion. In West Europe, industrial output rose only 2% last Winter, as compared to a rate double that in the previous three months. West German production is now leveling off, after a long rise. French output is actually falling.

The trend of business in Canada, though, is following ours. Economists have given up hope of a 1960 boom. The output of factories in on a plateau, while unemployment is on the rise. Money is easing up North, too, just as it is in this country. The one big bright spot is the improvement in foreign trade.

PRICES OF MACHINERY WILL HOLD STEADY during the next 12 months or so. A few types will go up but they'll be offset by declines in some other items. Costs of machinery makers will be rising because of higher wage rates, but excess capacity, higher imports and leveling business will hold down prices.

Here's the price outlook for the major kinds of machinery:

- Farm equipment, which has risen 1.5% in the past year, will hold steady. With farm income dropping, demand will fall.
- Electrical machinery will probably drop 1% in price, as the result of easing of demand and the pressure from imports.
- Construction machinery will increase by another 1% or so in the coming year. (Equipment prices rose 3.5% during the past year.) A rise in road-building this Summer will help.
- Machine tools have edged up a little this year, but they'll be steady for a while. Poor demand and imports are hurting.
- General purpose items--elevators, pumps, material-handling equipment, etc.--will move up by less than 1% on the average within the next few months. Then, prices will level off.

THREE NEW GOVERNMENT BOOKLETS which you may find to be helpful in your business are available for little or nothing from various federal agencies.

- "Small Business Pools for Defense" tells how to join with other firms to get orders from the government. It's free from the Small Business Administration, Washington 25, D.C.
- A guide to promotional allowances that are legal--or illegal --under the antitrust laws can also be obtained at no charge from the Federal Trade Commission (Washington 25, D.C.).
- County-by-county business data is available from the Census Bureau: "General statistics for Counties, 1958 Census of Manufacturers." It costs 50¢ from Census, Washington 25.

GET SET FOR A REALLY ROUGH CAMPAIGN FOR the White House this Summer and Fall. Political experts predict that it will be the roughest in decades. For one thing, both Nixon and Kennedy are young and ambitious. And they are tough campaigners. Another reason for roughness is the fact that the big issue will be foreign policy. Tempers are already frayed over the Summit blow-up and riots in Japan. Democrats are certain to make much of the handling of the U-2 incident. There's no big gap between the foreign policies of the parties. So the fight may have nowhere to go but to personalities.

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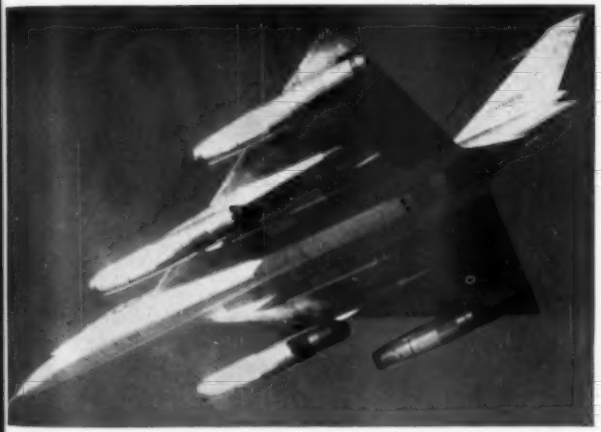

IN B-58 SUPERSONIC BOMBER, B.F.Goodrich high-strength adhesives are used to bond aluminum fuselage, wings and tail surfaces together. In metal laminates, adhesive bonding streamlines appearance, avoids stress concentration, and eliminates corrosion caused by contact of dissimilar metals.

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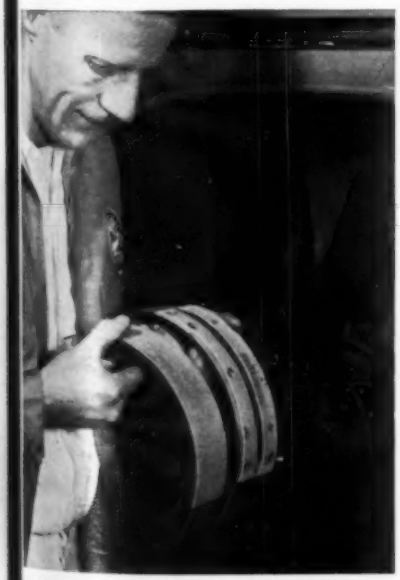


MORE THAN 175 MILLION BRAKE SHOES for new cars have been bonded with B.F.Goodrich adhesives . . . without a single known failure.

Bonding can also save weight, improve product design, speed assembly, reduce finishing costs

TODAY, B.F.Goodrich makes over 200 kinds of structural adhesives. These adhesives can permanently fasten metals, plastics, ceramics, glass —almost anything—to themselves or each other. In supersonic planes, car brakes, curtain wall panels, whirling helicopter blades, for example, adhesive bonding has proven to be stronger and safer than conventional fasteners.

New uses for high-strength adhesives are constantly being developed as we work with customers to find ways to improve product designs and assembly methods. If you mass-produce a product and think adhesive bonding might improve it, please write and give us full details. *B.F.Goodrich Industrial Products Co., Dept. M-892, Akron 18, Ohio.*

B.F.Goodrich

• **Valuable Export Aid.** The trade lists and world trade directory reports published by the Bureau of Foreign Commerce of the U.S. Department of Commerce can be considered an invaluable aid to exporters. These trade lists identify firms handling specific commodities in foreign countries and cover a wide range of products, trades and services. They also contain the basic information needed to locate customers, agents, distributors, licensees, and sources of supply abroad. Each trade list contains a summary of basic trade and industry data, a brief analysis of foreign trade in the commodity, government regulations affecting trade, and other useful market data.

Lists of importers and dealers indicate the relative size of each firm, method of operation, products handled, territory, and sales force. Lists of exporters and manufacturers also indicate relative size or production capacity of each firm and name the products handled. Adhesives are included in a list of chemicals, as well as their importers and dealers, or distributors. A second list includes the manufacturers of synthetic and organic chemicals. Trade lists of 68 different countries are available at $2.00 each. General lists covering about 40 smaller countries and areas where trade is not specialized, are available and are classified under the heading "Business Firms." In addition there are lists of state trading companies in Bulgaria, Czechoslovakia, the Soviet zone of Germany, Hungary, Poland, Rumania and Yugoslavia. All these lists can be obtained from the Department of Commerce in Washington 25, D.C., or local field offices.

• **World Trade Directory Reports.** These reports, published by the U.S. Department of Commerce, contain business information on individual foreign firms. They complement the trade lists service, and supply detailed information needed to determine the competence and reliability of specific foreign firms. Prepared by the American Foreign Service, they represent a consensus of reliable sources of information. If the report on file is more than a year old, a revised current report is prepared without additional charge. Reports cover companies and individuals in 180 countries. They can be purchased at $1.00 each through the U.S. Department of Commerce, Bureau of Foreign Commerce, Washington 25, D.C., or through any of the field offices of the Department.

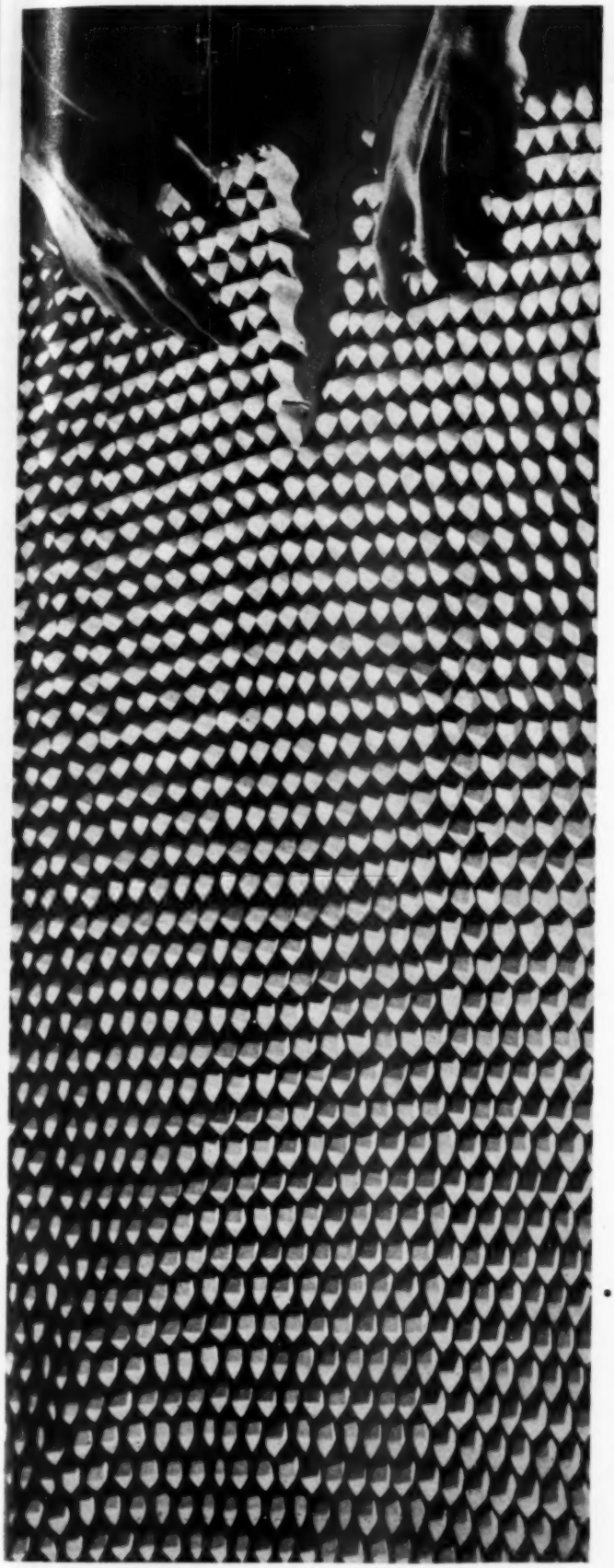
• **Advantages of Epoxy Adhesives.** The special value of epoxy adhesives lies in their character, their negligible shrinkage, their ability to cure without evolving volatile or corrosive matter. When cured, they are strong in cohesive strength as well as in adhesion. They are, therefore, capable of withstanding severe strain before breakdown, and they are resistant to most environmental conditions. To these qualifications can be added their practical convenience and the wide range of properties of different resin-hardener systems offered (e.g. resilient grades for bonding materials of different coefficients of expansion, gap filling types, etc.).

These adhesives are used at a relatively low temperature and joints can be made vacuum and pressure tight. Replacing "shrink and fit" methods by an adhesive greatly reduces the problem of machining to close tolerances. Then, bonding processes can be broken down into a number of relatively simple operations, which, while requiring care, do not call for a high degree of skill.

• **Applications of Epoxy Adhesives.** In addition to use in the bonding of primary structures of aircraft, other applications include the bonding of porcelain thread guides to metal studs and the bonding of light alloy bobbins in the textile industry. Mica windows have been bonded to the metal bodies of geiger counters, and tungsten carbide tops to tools, while heat exchangers, metal furniture and railway luggage racks and many other articles are assembled with epoxy adhesives Only one or two per cent resin is needed to bond iron powder to make the iron dust cores which are used for adjusting high frequency coils in electronic circuits.

• **German Trade Paper Discusses Adhesives.** Adhesives were discussed at great length in a special February issue of the East German trade paper "Plaste und Kautschuk" (Plastics and Rubber). Among the articles we would like to mention was "Polyurethane-Based Metal Bonding Adhesives," in which experiments with and without a catalyst in bonding aluminum with a polyurethane-based adhesive obtained by the reaction of Desmodur TH with a polyester containing hydroxyl groups, were covered. It was shown that polyester of a low OH number yields higher tensile/shear strength. Among the catalysts, xylenols and methyl or phenyl ethoxysilanes respectively, produced the best effect. The tensile/shear strength is influenced by the lap length, the amount of Desmodur TH used, and by the setting temperature. Bondings are only resistant to benzene, but not to water.

Another article of interest is "Selection and Use of Rubberlike Adhesives." The properties of rubberlike adhesives are influenced by the type of



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On the Continent (cont'd)

polymers forming the main constituent, and by the type and amount of modifier. As a result, considerable differences of flexibility, elasticity and stability of bonds are obtainable. The drying speed, too, can be varied.

"Use of Epoxy Resins as Low-Temperature Adhesives" discusses how the low-temperature resistance (up to 20°K.) of Cu/Cu bonds using epoxy resins with fillers was investigated in order to find out whether the magnetic coils of an electromagnet cooled by liquid hydrogen can be attached with epoxy resin based adhesives to the steel core. Different bonding properties were investigated including impact strength, notched impact strength, tensile strength, thermal stresses, and the influence of the thickness of the adhesive coating.

A number of additional articles, excerpts from important publications printed behind the Iron Curtain, and good make-up, characterize this particular issue. Anyone interested in the progress of the chemistry of adhesives in Soviet Russia, who understands German, should read this publication regularly. It can be obtained from the VEB Deutscher Verlag fuer Grundstoff-Industrie, Karl-Heine-Strasse 27, Leipzig W.31, East-Germany (Ost-Deutschland).

• **Bonding of Metals in East Germany.** An editorial published in the East German trade paper, *Plaste und Kautschuk,* is devoted to an evaluation of the East German accomplishments in the technique of bonding metals. It is stated that bonding, as the youngest method of joining metals, has met with great interest among the technicians and chemists. In 1955 a special committee "Bonding Technique" (Klebtechnik) was created in the Association for Machinery Construction, a sub-division of the Chamber of Technique. This voluntary technical association has been instrumental in the introduction of the bonding technique in industry. Two congresses held, one in 1956 in Berlin, and the other in 1958, in Leipzig, both attended by almost a thousand people from all parts of East Germany and foreign countries, were proof of the great response to the work of this particular section.

A special committee, "Metal Bonding," is divided into five sections: testing methods, bonding in the construction of machinery, bonding in traffic technique (cars, railroads), bonding in the building construction field, and finally bonding in the electrical field and in the construction of electrical appliances.

This committee is subdivided into quite a number of regional organizations and into special groups which exist in almost every factory. As all of these organizations have been created within a few years, the members can be proud of their accomplishments, and due credit can be given the governing committee.

The introduction of the new metal bonding techniques was contingent upon the available supply of suitable adhesives. The institute for plastic materials of the German Academy of Science in Berlin, in cooperation with the VEB Leunawerke "Walter Ulbricht," has accomplished a great deal in manufacturing epoxy resin metal bonding adhesives. Also the VEB Chemische Werke Buna in cooperation with the VEB Schuhchemie (shoe chemistry) in Erfurt, has been instrumental in the production of adhesives based upon "Plastikator-32-Basis."

In 1956 "a consulting and information office for metal bonding and faults in iron casting" was created in Berlin by the Ministry for general machinery construction. In 1958 this office was taken over by the Central Institute for Welding Technique. This Institute, which now encompasses the technical developments and the advisory service for various factories was started in 1959, and features instruction courses in the field of metal bonding technique.

• **Doing Business With West Germany?** Everybody doing business, or contemplating doing business with West Germany will find the new issue of the *Encyclopedia of Public Life* (Taschenbuch des Oeffentlichen Lebens 1960) a very valuable book. It contains 648 pages, and lists all the departments and offices of the Federal Government, the German Parliament, and all the other components of the government and central organizations. The second chapter is devoted to the organization of the "Laender" (States), and gives all particulars about their organization and representation in their respective parliaments, the courts, police and all other public departments. Included is a comprehensive listing of the organization of the most important cities and the legations and consulates representing Germany in foreign countries. Especially important is a chapter which contains a complete synopsis of all organizations of German industry and commerce, relating to domestic and foreign trade. Other chapters are devoted to the banking and stock exchanges, transportation, agriculture, cooperative movements, fairs, exhibitions, and organizations of the national economy. An outstanding chapter is devoted to science, as well as arts and other areas.

All told, the new edition contains names, addresses and factual information on 4,500 institutions and lists more than 8,000 individuals of importance in the German Republic. The book is published by Dr. Albert Oeckl, Festland-Verlag G.m.b.H., Postschliessfach 649, Bonn, and is priced at DM 14.— ($3.34).

• **Polythene Film Manufactured in Tanganyika.** The Metal Box Co. of East Africa Ltd. has acquired all the shares of Plastics (Africa) Ltd. and the company's plant at Ruaraka will produce polythene film for the packaging industry, in addition to continuing the production of water pipes.

ADHESIVES GUIDE

by JOYCE HURD

• A Practical Handbook

designed to serve as a guide to the types of adhesives available for bonding various materials in various applications. This new British publication covers adhesives used in woodworking, bookbinding, footwear, etc., and offers valuable data on the advantages of adhesive bonding and the classification of adhesives.

Topics Covered

Choice of Adhesives for Various Materials.

Encyclopedia of Basic Adhesive Types.

Classification of Manufacturers (British) by Basic Types of Adhesives Made

Catalog of Adhesive Manufacturers and Their Products

Trade Name Index (British)

Miscellaneous Adhesive Recipes

British Organizations Concerned With Adhesives

Bibliography

With contents including data on something like 400 individual adhesives made by about 100 different manufacturers, this publication will prove to be a valuable edition to your technical library. More than 50 main types of adhesives and their properties are covered!

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By FRANK FISHER

Stein Hall & Co., Inc.
Long Island City 1, New York

Latex-Based Adhesives

A detailed survey of the various procedures and types of equipment available to the control chemist for testing to see whether a given adhesive batch is up to standard

Natural rubber is available in latex form in several qualities that differ only in the method of concentration, the polymer remaining the same, *i.e.*, natural rubber.

Type	*Total Solids*	*Non-rubber constituents*
Normal	40	variable
Centrifuged	61.5 min.	2.0 max.
Creamed	64.0	2.0 max.
Heat Concentrated	73	high

The "normal" type with its high water content has nearly vanished from the market. It is latex as the trees yield it, only strained to remove impurities and ammoniated to protect it against putrefaction.

"Centrifuged" latex has been partially de-watered in the same way as milk is converted into cream by passing it through a centrifuge. Here too ammonia acts as the preservative.

"Creamed" latex is prepared by first diluting the "normal" to about 30 per cent solids by the addition of water and a suitable gum (locust bean, karaya), allowing the mix to rest for several days when the rubber floats to the top to leave at the bottom of the vessel a clear serum which can be drawn off. The accumulated cream is richer in rubber than the "normal" latex.

"Heat concentrated" latex has lost the excess of water by evaporation under controlled conditions of heat and time. Of the remarkably high total solids, up to ten per cent may be non-rubber constituents. "Centrifuged" and "creamed" types are available also as "low ammonia" qualities, part of the ammonia having been replaced by potent bactericides. Details of composition and testing methods for uncompounded natural rubber latex can be found in the ASTM standards under designation D 1076-59 (*1*).

Among the synthetic rubbers those made by copolymerizing butadiene with styrene represent the most widely used variety. Formerly known as GRS (government rubber, synthetic) they are now classified under the heading of SBR (styrene butadiene rubber). Their composition is mostly 75 per cent butadiene and 25 per cent styrene. A higher butadiene content makes for a softer rubber. A higher styrene content leads progressively to harder rubbers and over 60 per cent of styrene confers on the dry rubber film the characteristics of a resin. The total solids cover the range from 62 per cent down to 25 per cent.

The nitrile latices contain a rubber-like synthetic composed of a copolymer of butadiene and acrylonitrile in proportions varying from 55 per cent butadiene and 45 per cent acrylonitrile to 70 per cent butadiene and 30 per cent acrylonitrile. The total solids cover the range from 55 per cent to 32 per cent. In general it can be said that with higher acrylonitrile content the oil resistance increases and the tack decreases. (*2*).

The neoprene latices comprise a group that contains as the solids polymers of chloroprene or its copolymers of undisclosed composition. They all are solvent and flame resistant. The total solids content varies between 35 per cent and 60 per cent. (*3*).

Before going any further, it might be advisable to define the meaning of the words "testing" and "latex" in the context of this monograph.

"Testing" will mean the application of methods whereby a chemist will be able to find out whether a latex-based adhesive has been properly produced, whether it will survive transportation and if so, what might be its shelf-life and whether it fits the requirements of the applicating machine. No attempts will be made to evaluate the performance, depending as it does on the nature of the surfaces to be joined.

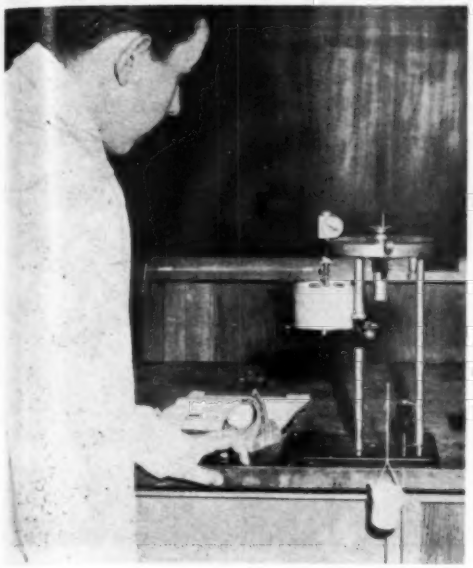
"Latex" will be restricted to encompass those milk-like liquids which contain natural rubber, styrene/butadiene rubbers, the nitriles and neoprene. A comprehensive tabulation of the numerous types of synthetic latex can be found in the *Vanderbilt News (4)*.

Various Testing Procedures

Odor—The odor of a latex-based adhesive can tell a story. Natural rubber latex is associated with ammonia and most of the SBR types have an odor of styrene; neoprene has an odor of its own. Often these particular odors are masked with a perfume which makes it all the more difficult to discover odors given off by putrefaction.

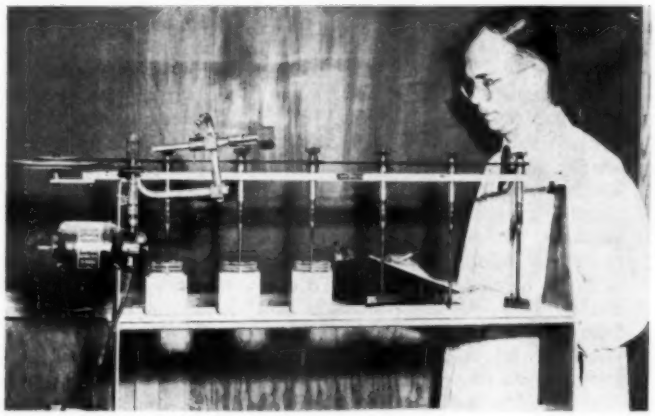
Ammonia can easily be neutralized with the addition of a little saturated boric acid solution whereas the smells given off by styrene and neoprene are persistent. Practice is required to discover underneath these smells the odor due to putrefaction such as hydrogen sulfide. The appearance of a putrefactive odor may indicate for instance that a protective colloid of animal or vegetable origin has

Testing for Viscosity and Mechanical Stability



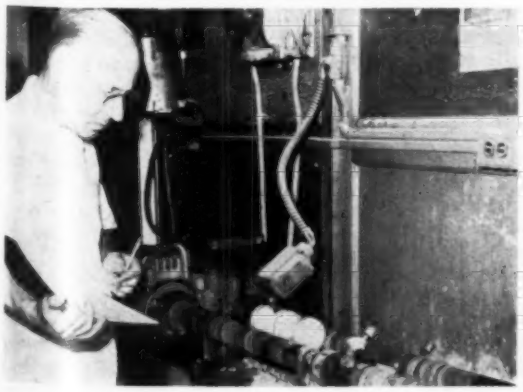
The Stormer unit shown here measures viscosity by ascertaining the time a cylinder requires to perform a given number of rotations in a sample.

A Klaxon Mechanical Stability Tester is used to determine if sample indicates that latex shipment is suitable for use in adhesives.

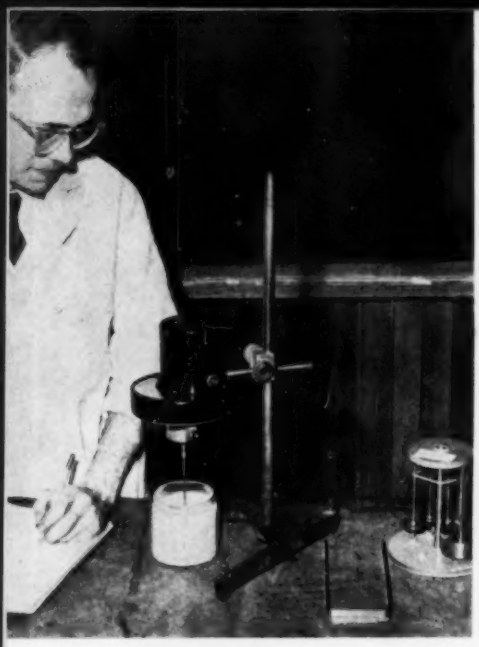


Six-place Blair Stirrer permits testing the mechanical stability of a latex sample by noting results of slow and prolonged agitation. Interpretation of results obtained has to be based on experience of researcher conducting the tests.

In Roller Tester unit, a jar of adhesive is placed between two slowly revolving horizontal rolls to test sample's stability.



With Hamilton-Beach Malt Mixer stability may be expressed as time required to coagulate adhesive specimen into solid lump.



The Brookfield Synchro-Lectric Viscometer is an instrument of the rotational type.

The Zahn Cup is probably the most simple type of instrument available for measuring the viscosity of an adhesive sample.

Another viscosity tester is the Ford Cup, a metal container with a conical bottom and a lip rim to catch specimen overflow.

started to decompose. In due course the adhesive will thicken up, then coagulate or flocculate.

Total Solids Content. The formula allows the chemist to calculate the expected total solids content and the actual determination offers a valuable means of production control. It is sufficient to weigh about three grams of the sample into a tared glass or aluminum dish (keep the cover on while weighing!) and to dry for 16 hours in a vented air oven at 70°C. with the dish uncovered. The usual routine of cooling in a desiccator and weighing follows. If the weight of the sample is denoted by W and that of the dried film by D, then the per cent total solids is given by D/W x 100.

It is not wise to exceed 70°C. because volatiles could be driven off that are intended to remain in the adhesive film. Also the sample might form a dry skin and remain wet underneath.

Examination of the dry film for presence or absence of tack, color, odor, hardness, brittleness, especially in comparison with a standard specimen furnishes valuable clues as to the quality of the material under test. Instead of relying for examination on the small piece of dry material left over from the test for total solids, it is good practice to place about ten grams on a large petri dish and dry it together with the specimen for total solids. In this way a larger surface is available for examination, especially if plasticizers or oils bleed to the surface in the shape of "sweat pearls." More about the testing of dry films will appear under the heading of "Aging."

Viscosity. Gluing operations usually impose well defined limits to the viscosities of the adhesives depending upon the method of application. The control chemist has to decide—and quickly—whether or not a batch is acceptable. To do this he may use any yardstick he finds convenient to measure the viscosity; he is not interested in learning how many scientifically precise poises or stokes his mixes exhibit.

Measuring Methods

Of the four methods of measurement, the one based on flow through a capillary tube is time consuming and not suitable for liquids with high viscosity and therefore will not be discussed. The second method compares the flow through an orifice, either a short tube of varying diameters or a circular hole at the bottom of a container. The third method is called the "rotational" because its principle is based upon the drag exercised by the liquid under test upon a revolving body which might be a cylinder, a disk or the container itself. The fourth method measures the time taken by a sphere to fall a chosen distance through the liquid, or ascertains how long an air bubble needs to rise to the surface.

Examples of the instruments with an orifice are the Saybolt Viscometer, the Zahn Cup and the Ford Cup. *(5).* The Saybolt instrument is a jacketed cylinder holding about 75 ml with a discharge orifice about 10 mm long and 3 mm in diameter. Removal of a cork at the bottom starts the flow. The viscosity is measured by timing how many seconds are required to discharge exactly 60 ml into a calibrated vessel under free gravity. The results are referred to as "Saybolt seconds." While the results are reproducible, cleaning the instrument is time consuming.

The Zahn Cup (actually a set of five cups whose orifices differ in size) is the most simple type of instrument. It consists of a metal cylinder holding about 50 ml with a round bottom which has a circular orifice. The cylinder is fixed to a footlong handle of stiff wires by which it can be submerged into the liquid. Upon quick withdrawal it is found to be full to the brim and a stop watch measures the time required to drain.

The operation is quick and so simple it can be performed by unskilled labor but the results are not readily reproducible, especially with liquids of medium and high viscosities that tend to cling to the walls and start dripping towards the end.

With the paint industries the Ford Cup is popular. It is a metal container with a conical bottom and a lip around the rim which catches the overflow. At the lowest point of the cone, orifices of various sizes can be screwed in. In measuring, the container is first filled to overflow while the orifice is kept closed by the tip of a finger. Upon release, the liquid flows out and again a stop watch measures the time required to drain. Like the Zahn Cup, the Ford instrument is easy to handle and is subject to the same limitations with viscous and clinging liquids. Both instruments are cleaned easily.

Rotational Instruments

Instruments of the rotational type measure the resistance of the liquid to the rotation of an immersed body in the shape of a cylinder, a disk or paddles. Some of them require the test to be performed in a special container because the clearance between its walls and the rotating body influences the result; others permit the use of any vessel large enough so as not to interfere with the rotation.

The Stormer instrument determines the viscosity by ascertaining the time a cylinder (or other type of rotor) requires to perform a fixed number of rotations. The driving force is provided by variable weights suspended on a string which is wound around the rotating drum. For purposes of comparison the time is recorded, but the instrument may be calibrated with liquids of known viscosities and then the time value can be converted into centipoises.

The Brookfield Synchro-Lectric Viscometer is the most easily operated instrument of the rotational type. Its range reaches from watery thin liquids to semi-pastes, and its function does not depend upon the shape or size of the container. Cylinders or discs rotate in the liquid and the drag exerted upon them is measured by the distortion of a calibrated spring.

Since the instrument can be operated at four different speeds and the immersion spindles vary considerably in size, a wide range of viscosities can be covered. Measuring the viscosity at two speeds permits conclusions to be drawn as to the nature of the flow: thixotropic or dilatant. Positioning a chilled or heated container does not require elaborate changes in the set up of the instrument. For cleaning, only the spindle and its guard have to be rinsed.

The fourth method—falling sphere—is best represented by the Hoeppler in which a steel ball falls through the liquid in an inclined and calibrated glass cylinder. Balls of different diameters permit the measurement of widely different viscosities, expressed in seconds which can be converted into centipoises. The instrument is not suitable for opaque liquids—which preclude the observation of the ball—and cleaning is troublesome.

It is advisable to determine the viscosity at two levels of shear: for instance on the Brookfield instrument at 60 and 30 rpm. If the viscosity is lower at the higher speed then the adhesive is said to be thixotropic. It may thicken up on standing but stirring will thin it down. Application by a roller or under a doctor blade will not present any difficulty.

"The control chemist has to decide—and quickly—whether or not a batch is acceptable . . . he is not interested in learning how many scientifically precise poises or strokes his mixes exhibit."

If the viscosity is higher at the higher speed, the mix is said to be dilatant. The more it is worked the stiffer it gets. It flows under its own weight yet tends to get solid when stirred. In general, such adhesives can not be used on regular equipment. They stall a stirrer, build up on rolls and create streaks under a doctor blade.

A "viscosity index" helps to keep check on the flow characteristics. For instance the viscosities ascertained with Brookfield spindle No. 3 were 3440 cp at 30 rpm and 4200 cp at 12 rpm. The fraction 3440/4200 is the said index-0.819. For thixotropic fluids the value lies always below 1 and the lower it is the more thixotropic is the mix. Conversely values above 1 indicate a dilatant mix.

Mechanical Stability. The determination of mechanical stability helps to predict how the adhesive would survive the vibration during transit and the shearing action of the applicator in actual use. In this way, it gives a hint how long it will last in storage (shelf life).

The simplest device is a Hamilton-Beach Malt Mixer although its results belong in the category "rule of thumb" as there is no provision for controlling the speed or even knowing what it is. The size and shape of the container should be standardized, *e.g.*, an 8 oz. glass bottle, square or round, filled with 100 grams of the mix under test.

The stability is expressed as the time required to coagulate the adhesive into a solid lump or into tiny bits floating in a serum. These mixers run with high speeds and may not be suitable for high viscosity adhesives which may get steaming hot from the friction of the revolving stirrers against the liquid. A modified version of this mixer with close tolerances as to speed and dimensions of stirrer and container is used for mechanical stability testing of natural rubber latex. A detailed description and specifications can be found under ASTM D-1076 *(1)*.

Slow and prolonged agitation permits closer inspection of the changes taking place. A simple yet effective arrangement consists of a stainless steel stirrer in the shape of an inverted "T" revolving slowly inside a glass jar. The speed is adjustable and should not exceed 60 rpm. Often a battery of six such stirrers is driven by a common motor to permit simultaneous observation under identical conditions.

A suitable instrument is the Blair Stirrer as used for metallurgical work. It has six places and is high enough to permit insertion of a water bath for heating or cooling. It is advisable to plug in a rheostat between the motor and the outlet in the wall. This makes it possible to slow down the speed below the minimum of the motor—which in most cases is far too high. Compounds of high mechanical stability may survive several days while others might thicken up or coagulate within a few hours. Because of the slow speed, the change is not abrupt and can be followed closely. The interpretation has to be based on experience. In general it can be said that 12 hours is the minimum requirement. The end-point is reached when coagulation to a solid lump occurs or when agglomerates appear.

With newly designed formulas the

test is best repeated at intervals of a week. A rapid fall in the time required to reach the endpoint indicates that the material might coagulate when the purchaser stirs it prior to use or when it's churned by the applicator on the gluing machine. With natural-latex based adhesives the appearance of the "orange peel" effect on the surface is a sure sign of poor quality.

A different type of mechanical stability manifests itself in the roller test. A glass jar half filled with the adhesive is placed between two horizontally revolving rolls, the revolutions being slow enough so as not to throw the liquid on to the glass walls by centrifugal force. A gradual thickening may develop, also frothing. The interpretation requires knowledge of the intended use, *e.g.*, frothing may indicate that the adhesive should not be used for application by roller-coater.

A time-honored shop test so simple that it can be performed without any instrument at all merits mention here. It was the first and only method available to judge the quality of natural latex when it was a novel commodity and not much was known of its properties.

Place a little on the palm of your left hand and rub it with the index finger of your right hand in a circular motion, pressing gently. Count the number of circles until the latex (or the adhesive) changes from a liquid to rolling longitudinal crumbs. A higher count means a better material. Instant solidification is a danger signal.

Spreading. With latex-based adhesives, this test reveals the presence of solid bits. They may have been present in the mix prior to its being spread and in such a case indicate either faulty compounding or the first traces of coagulation. They may also have developed under the spreader blade, in which case they signal too low a mechanical stability.

A sheet of thick flat plate glass serves as an ideal flat surface. On it is placed and smoothed out a specimen of the material to be glued—generally paper or metal foil. The spreader may be a Bird Applicator or a glass rod of at least 15 mm diameter. The Bird Applicator is essentially a straight metal edge acting like a doctor blade which is held a specified distance—say 0.005 in. —from the surface underneath. It can easily be seen that with such a close setting all unevenness on the surface of the material under test has to be avoided. The same applies to spreading by a glass rod.

Examining Wet Film

After the spreading, the still wet film is examined. Are there dry spots? Or bits? Or perhaps "fish eyes?" The dry spots are due to poor wetting and as this phenomenon is not peculiar to latex based adhesives it will not be discussed here.

If the bits appear as dots it can be assumed that they were present before the spreading. If they appear elongated with the longer side parallel to the direction of the spreader it is probable that friction caused their formation. It should be borne in mind that pre-existent bits might have been "smeared out" and thus exhibit orientation.

A poor performance under the slow speed stirrer generally heralds the appearance of bits. The best way to distinguish between bits present as such in the adhesive and those formed by friction during the spreading is to dip a stainless steel spatula into the adhesive, let the excess run off and view the spatula at an angle so that it reflects the incident light. On its mirror-like surface the tiniest bits will show up distinctly.

Sedimentation and Creaming. Uncompounded natural latex forms cream—just as milk does—when left standing undisturbed. The cream may be stirred back to reconstitute the original quality. Care is required if the latex (or the adhesive made from it) has stood so long as to permit the formation of several inches of thick cream. Such cream is extremely sensitive to agitation and an attempt to break it up by high speed stirring as under a propeller type mixer will coagulate it.

In such cases it is best to cut the surface gently with a large spatula and perform the mixing with a slow running stirrer of the Christmas tree type: a vertical shaft with horizontal arms.

Adhesives based upon natural latex may tend to cream as described but at the same time may also manifest sedimentation when compounding materials heavier than water tend to accumulate at the bottom. This is a source of trouble when customers omit to stir the adhesive prior to use.

Gum solutions added to modify flow and viscosity speed up the creaming (arabic, karaya, locust bean), anti-oxidants form sediments. Resting the adhesive in graduated cylinders, or in separating funnels, over weeks or even months permits easy inspection.

Aging. While the foregoing paragraphs were concerned with the liquid adhesive, we will now turn to the inspection of dry films. It is realized that the industry tests its products as adhesives spread on the surfaces they are intended to join under carefully controlled conditions of temperature-humidity-time. The simple test described here is meant to explore the properties of the film and not its performance on the assumption that if a specimen fails the test it will not be good as an adhesive.

As mentioned under the heading of Total Solids it is good practice to place a few grams on a large petri dish and dry them at 70°C. The construction of the oven is described in ASTM Designation D 573-53 *(6)*. As the film rests on glass it will be judged on its own merits without the necessity of observing the influence of paper or metal foils.

Before the film is placed into the oven it is carefully examined for

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defects that originate during the drying. Any cracks? Sweat pearls? Every 24 hours the dish with the film is removed from the oven, cooled in a desiccator and inspected for changes such as discoloration, softening or hardening, increase or decrease of tack. The test may be speeded by running it at a higher temperature, say 100°C., even so, observation over several days may be necessary.

Rule of Thumb

Setting-up the specification requires comparison with approved adhesives. The rule of thumb current in the rubber industry—"The first day at 70°C. is discounted, every following day equals six months service life"—is approximate for rubber compounds such as rug backings and unreliable for adhesives.

pH Value. Adhesives made from natural rubber latex, nitrile, butadiene-styrene and neoprene are on the alkaline side. Although a drop in the value during storage is common it signals danger when it nears 9.00; newly formulated compounds should be checked daily for a week, then at one week intervals for at least one month. If the pH value gets too low, adhesives based upon natural rubber and neoprene will form a solid cake while SBR is more likely to form crumbs. As the pH drops, the mechanical stability will get worse and the viscosity will increase.

With latex-based adhesives compounded to widely differing formulations to serve as widely differing purposes, no hard and fast rules can be set up to cover all possible formulas. The control chemist has to devise his methods according to his experiences with the products made under his supervision and to this end the bad ones are as important as the good ones.

Literature References

(1) "ASTM Standards on Rubber Products" (with related information) 19th edition, March 1960, p. 578 ff

(2) "Tech-Book Facts No. 58-48," Goodyear Chem. Div.

(3) "Catalog of DuPont Elastomers and Chemicals," prepared by S. W. Schmitt, published by Elastomer Chemicals Dept. E. I. DuPont De Nemours & Co., Inc.

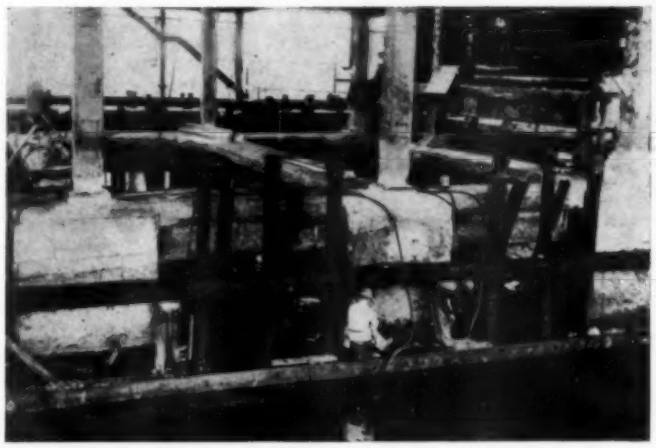
(4) Vanderbilt News Vol. 25, No. 5, Oct. 1959 published by R. T. Vanderbilt Inc., 230 Park Ave., New York 17, N.Y.

(5) Paul Becher, "Emulsions" ACS Monograph Series, p. 317 ff.

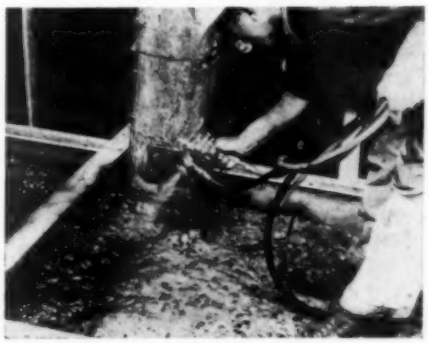
(6) "ASTM Standards on Rubber Products" (with related information 19th edition, March 1960, p. 318

Operation Salvage

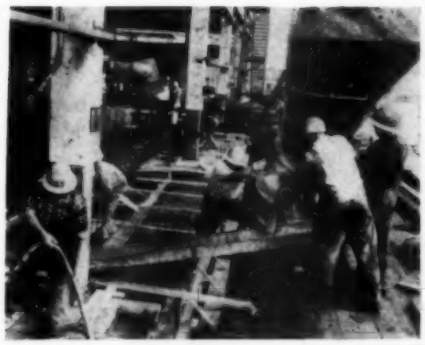
Resurfacing Pile Caps



1 When the nearly completed South Bronx Marine Transfer Terminal was hit by fire, engineers thought it would have to be dismantled because the damaged supporting concrete pile caps could not be resurfaced.



2 It was found, however, that by spraying a polysulfide-epoxy adhesive on cleaned up pile caps, a watertight bond could be formed between new and old concrete.



3 Thirty minutes after the spraying, new concrete is poured into forms. The salvage operation is expected to cut construction time by almost three years.

Vinyl Alkyl Ether Pressure-Sensitive Adhesives

Compatible with a broad spectrum of additives, extenders, plasticizers and tackifiers, vinyl-based polymers are used in making an extremely wide range of adhesive products

The adhesives industry shares with the plastics industry a common interest in the small but versatile chemical radical, $CH_2=CH-$. Termed the vinyl radical or group, it is the building stone for countless plastics. Modified by the addition or substitution of other groups and polymerized, it becomes polystyrene, polyethylene, SBR rubber, polyvinyl alcohol, polymethylmethacrylate and many other equally diverse and useful polymers.

Seeing these materials in the form of molded, extruded, cast and laminated products the layman generally is unaware of their significance as adhesive raw materials. Yet from these vinyl-based polymers comes an array of adhesives whose variety in type and use is unequaled. They can be used as aqueous solutions and dispersions, as solutions in organic solvents and as hot melt adhesives. Excellent adhesion is obtained with both porous and non-porous materials. Adhesive strength ranges from extremely strong bonds to bonds sufficiently weak and permanently elastic so that they can easily be parted with no damage to the adherends.

Included in the latter type are the pressure-sensitive adhesives. It is the purpose of this paper to discuss a class of vinyl derivatives that has become prominent in recent years for such adhesives, the vinyl alkyl ether polymers.

These resins are light in color and appear colorless in coating thicknesses, include very tacky as well as tough rubbery types and are compatible with a broad spectrum of additives, tackifiers, plasticizers and extenders.

The monomer molecule is simply depicted,

$$CH_2=CHOR$$

where R represents a low molecular weight member of the alkyl group, such as methyl, ethyl, propyl, etc. Many methods have been proposed for the synthesis of the simple vinyl alkyl ethers. Some work was done before the turn of the present century; for example, in 1891, the Russian scientist, Favorsky, reacted methyl acetylene with ethyl alcohol in the presence of alkali to obtain α-methylvinyl ethyl ether *(3)*.

Early Work

The important early work was undoubtedly that of W. Reppe and co-workers at I. C. Farben in Germany. Reppe prepared vinyl ethers by reacting sodium alcoholates with vinyl chloride, vinylidene chloride, or ethylene chloride:

$$CH_2=CHCl + NaOC_2H_5 \xrightarrow[\text{In ethanol}]{100°C} CH_2=CHOC_2H_5 + NaCl \quad (5)$$

During the course of this reaction it was noted by Reppe that some acetylene was formed and later disappeared. This discovery led Reppe to attempt the direct vinylation of alcohols by acetylene:

$$ROH + CH\equiv CH \xrightarrow[130\text{-}180°C]{KOR} CH_2=CHOR \quad (6)$$

This reaction became of commercial importance in Germany during World War II, when considerable quantities of several vinyl alkyl ether monomers were produced as intermediates for polymer production. Both batch and continuous processes were developed.

In another commercially interesting synthesis, acetaldehyde is reacted with an alcohol to yield an acetal which is split to give the desired vinyl ether:

$$CH_3CHO + 2ROH \xrightarrow{\text{catalyst}}$$

$$CH_3CH(OR)_2 \longrightarrow CH_2CHOR + ROH \quad (10)$$

Most of the simple vinyl alkyl ethers are colorless liquids at room temperature, although the methyl homologue is a gas, and members with sufficiently long chains, *e.g.*, octadecyl, are solids. These ethers have pleasant odors and are of low toxicity, although the lower members do exhibit some anesthetic properties. They are only slightly soluble in water, but miscible with many organic solvents. Properties of some of the lower molecular weight vinyl alkyl ether monomers are shown in Table I.

The pure dry monomers can be stored indefinitely without undergoing polymerization. They hydrolyze slowly in the presence of water and rapidly with dilute acids. Commercial monomers generally contain small amounts of triethanolamine to stabilize the materials against possible hydrolysis by moisture.

Polymerization of the vinyl alkyl ethers is not easily accomplished by heating or by use of the usual peroxide catalysts. The early work

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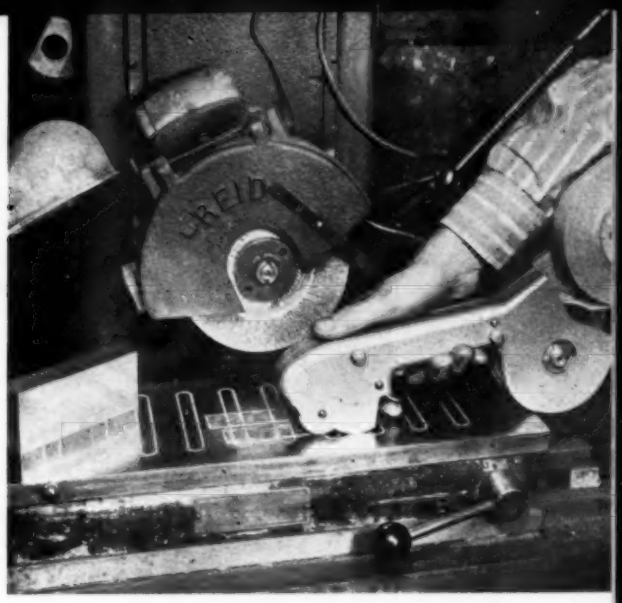


Double-faced tape coated with a polyvinyl ethyl ether-based adhesive holds a piece of non-magnetic material on a magnetic chuck.

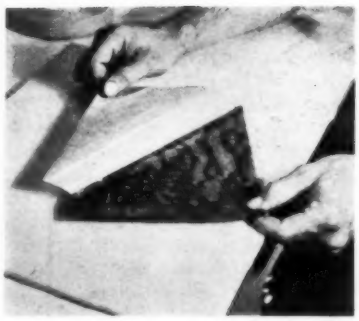
which was carried out at room temperature and with iodine as catalyst, resulted only in low molecular weight polymers which were viscous liquids *(11)*.

Reppe and his co-workers developed polymerization techniques utilizing as catalysts, aluminum chloride, zinc chloride, sulfur dioxide, boron trifluoride and other materials *(7)*. These reactions, carried out at room temperature or above, were generally quite violent and only low polymers were obtained, which found little if any commercial use. In the late 1930's, solid polymers were offered for the first time by I. G. Farben, but these were based on long-chain alkyl vinyl ethers, *e.g.*, vinyl octadecyl ether, and also were low polymers. They were used chiefly as waxes and had no properties making them useful in adhesive applications.

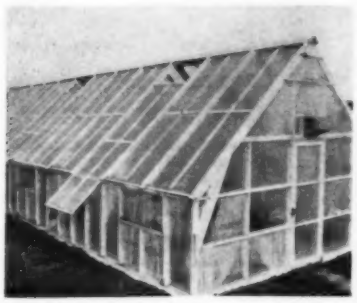
German Research

Following World War II, teams of American scientists who investigated the German economy found that the country's lack of natural raw materials had accelerated research in many fields. One of the successful German accomplishments was the development of methods for producing high polymeric material from the short-chain alkyl vinyl ethers. It had been discovered that if the polymerization using boron trifluoride catalyst were carried out at very low temperatures, a high molecular weight product could be made.

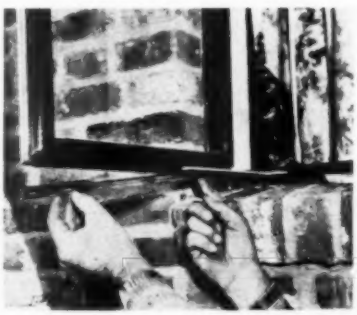
The equipment for continuous processing was novel. It consisted



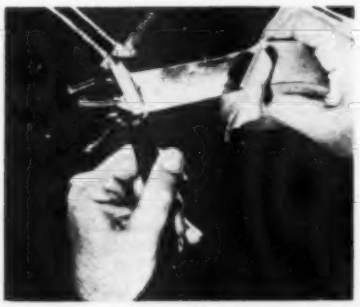
Application of double-faced adhesive film to a plastic foam surface. After the protective release sheet is stripped off, the foam can be pressure-sensitized or bonded instantly to any type of surface.



This greenhouse was made with polyvinyl ethyl ether-based adhesives. The prefab panels of polyethylene were bonded to the light wood frames in the factory.

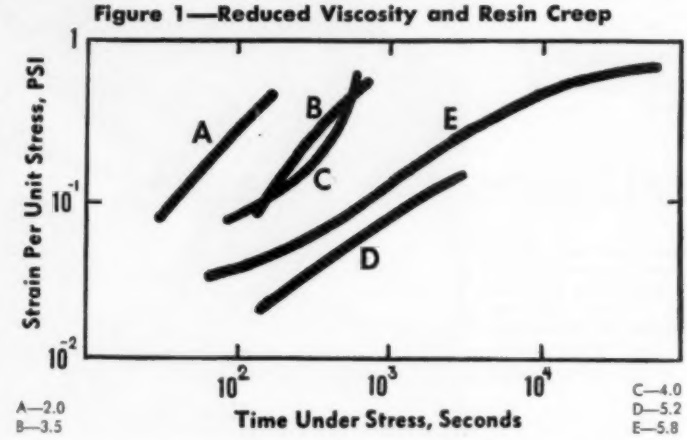


The application of a pressure-sensitive adhesive to the aluminum channel holds it in place while it is drilled to form part of the storm sash shown here.



Splices in high voltage wires can be protected with bendable Teflon. The advantages of the tape are zero moisture absorption, good insulation, long life and ease of application.

Figure 1—Reduced Viscosity and Resin Creep



A—2.0
B—3.5
C—4.0
D—5.2
E—5.8

Figure 2—Creep vs. Reduced Viscosity and Film Thickness

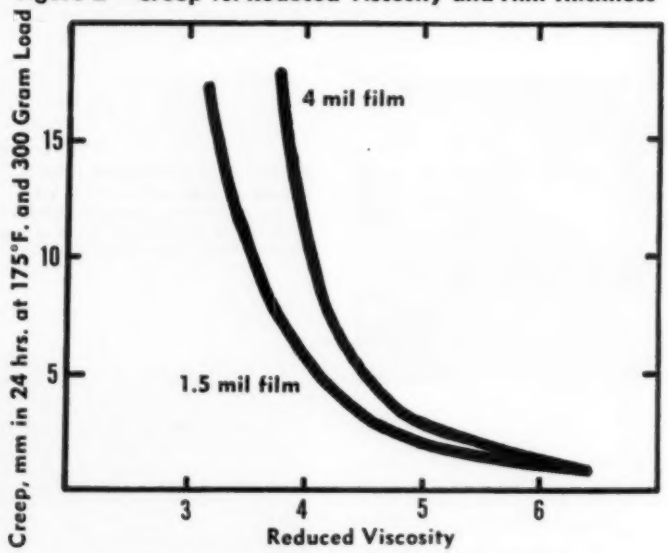
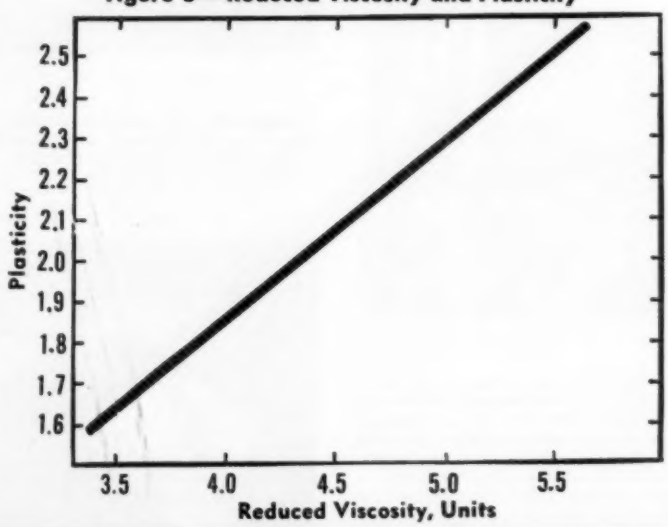


Figure 3—Reduced Viscosity and Plasticity



basically of an endless belt carried on two horizontal steel drums, the whole being submerged in water up to the axles of the drums and enclosed in a steel tank. Solutions of the ether and the catalyst in liquid propane chilled to −60°C. were squirted through separate feed pipes onto the moving belt. Polymerization was almost instantaneous. The product formed was carried under water by the belt and removed so as not to break the water seal of the reaction vessel *(1)*.

High molecular weight polymers of vinyl ethyl ether and vinyl isobutyl ether were produced in quantity and found satisfactory application as pressure-sensitive adhesives for medical adhesive tape, electrical tape. They were also used in water-based adhesives and textile sizes. Although useful products were obtained, the processes, both continuous and batch, were difficult to control.

Process Control

A major development which does permit good process control and associated uniformity of product was the discovery by S. A. Mosley of a new catalyst for vinyl ether polymerization *(4)*. The activity of the catalyst, a specially prepared aluminum hexahydrosulfate, is such that it is possible to conduct the laboratory synthesis at the reflux temperature of the process solvent, which can be toluene, hexane, heptane, etc. The reaction temperature is controlled automatically by the boiling point of the solvent system; and by varying other factors, materials with different degrees of polymerization are obtained.

In the production process, the vinyl alkyl ether solution is treated with the catalyst in scraped surface heat exchangers where polymerization occurs rapidly. Because no unwanted by-products are formed, all that is required to finish the product is to filter and adjust for total solids if the solution form of the product is desired, or to pass through a twin screw drying mill and extrude into slabs to obtain the solvent-free, 100 per cent solids form.

Variation in the type of structure of the polymer causes profound differences in the physical and other properties of the vinyl alkyl ether polymers. If their preparation is conducted under conditions permitting very slow polymerization over a period of several hours, highly crystaline, non-tacky products are formed. The materials resulting from

such a slow *proliferous-type* reaction tend to be long, relatively unbranched chains. An idealized molecule of a polymer of this type can be pictured as a collection of perhaps two thousand of the monomer molecules linked together in one long chain.

On the other hand, process conditions can be established so that *flash* polymerization takes place resulting in non-crystalline, tacky products. In this case, the polymer is formed almost instantaneously, the same two thousand or so molecules linking up to form one molecule of polymer, but in a highly disorganized manner. Instead of a simple, long chain, each molecule, though starting as a chain, quickly begins to branch, with subbranches growing from these. In a fraction of a second the reaction is completed.

In actual practice, neither perfectly unbranched chains nor infinitely branched ones are formed. A product may comprise a greater or lesser proportion of one or the other. This variation is quite sufficient to modify their properties strongly. It is also to be understood that not all the molecules comprising a given polymeric substance are of the same weight or length, but vary over a considerable range around some average. (The example of two thousand monomer molecules forming one polymer molecule is merely illustrative of such an average, a reasonable figure but not established in fact.)

Wide Weight Range

With this picture of a polymer as a collection of chemically similar material, but of molecules varying over a wide range in weight and in degree of branching, it becomes clear why a single criterion—reduced viscosity, estimated average molecular weight or any other—is totally insufficient to permit predictions of other characteristics. Only within one family of products, made under the same process conditions, can orderly change in one property be expected to result from orderly change of some controllable factor. Under different process conditions, products formed from the same raw materials may have identical reduced viscosities, but being composed of entirely different assortments of molecules, will vary unpredictably in many other characteristics *(9)*.

This picture of a polymer also points up the necessity for speaking in broad generalities about the characteristics of the vinyl alkyl ether polymers as a class, or specifically about an individual product.

A general characteristic of the vinyl alkyl ether polymers is that they are non-linear viscoelastic materials, that is, they exhibit in varying degree the characteristics both of a viscous liquid and of a true elastomer. The term "non-linear" refers to the fact that the stress produced in these materials by a strain is not proportional to that strain. If one unit of strain results in one unit of stress, and the sample is maintained under that load for a period of time, then the second unit of strain will result in less than one additional unit of stress. Some viscous flow will have taken place, allowing the sample to relax *(2)*

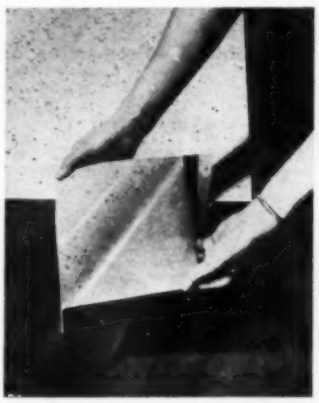
High-Temperature Flow

The elastic properties diminish with increased temperature, giving way to predominantly viscous flow at high temperatures. The elastic properties increase with increase in reduced viscosity (with the proviso that all process conditions are controlled as closely as possible so as to make a series of products comparable). This is demonstrated in Figure 1, which shows that the least creep occurs as high reduced viscosities. The relationship is not perfect since these are experimental, not ideal, samples.

Within the same family of vinyl ethyl ether resins, the reduced viscosity does offer a reasonable estimate of creep. In Figure 2 are plotted data for 12 samples of resins, having reduced viscosities of 3.2 to 6.3. Reduced viscosity data was obtained on solutions of 0.1-gram of polymer in 100 ml. of hexane at 20°C. Creep was measured by adhering ½-inch wide strips of cellophane coated with 1.5 mils of the resin to vertical panes of glass, loading the strips with 300-gram weights and determining the amount of creep at the end of 24 hours. An area of one square inch was in contact with the glass, and the tests were conducted at 175° F.

Plasticity measurements, for example, as made by the Williams parallel plate method, are widely used in the evaluation of adhesive formulations. Plasticity and reduced viscosity exhibit a good correlation as indicated by Figure 3.

Electrical properties of the vinyl alkyl ether polymers as a class are such as to permit rough comparisons with other dielectric materials. In



1 Soon to be available are vinyl tiles pre-coated with pressure-sensitive adhesive protected with release paper.

2 The release paper is peeled off and the tile is set into position on a floor previously freed of dirt and grease.

3 Foot-pressure sets the tile in place. The more the floor is walked on, the tighter the tile is bonded to it.

Table I—Properties of Vinyl Alkyl Ether Monomers

	B.P., °C	*M.P., °C*	*Spec. Grav. 20/20°C.*	*Sol. in H_2O at 20°C,%*
Methyl vinyl ether	6	−122	0.7500	1.5
Ethyl vinyl ether	35.5	−115	0.7451	0.9
Isopropyl vinyl ether	55	−140	0.7545	0.6
n-Butyl vinyl ether	94	− 92	0.7803	0.1
Isobutyl vinyl ether	83	−112	0.7706	0.1
2-Ethylhexyl vinyl ether	174	−100	0.8102	0.05

Table II—Properties of Commercial Vinyl Ethyl Ether Resins

	Low Viscosity		*High Viscosity*		*Extra-High Viscosity*	
Product[1]	EHBC[2]	EDBC	EHBM[2]	EDBM	EHBN[2]	EDBN
Non-Volatiles,%	80	98	25	98	25	98
Reduced Viscosity, 20°C	.3±.1	.3±.1	4.0±.5	4.0±.5	5.0±.5	5.0±.5
Plasticity, mm.	—	—	1.6—2.0	1.6—2.0	2.0—2.4	2.0—2.4

[1]All products listed are Bakelite Brand resins. [2]Solutions of the resin in hexane.

Table III—Effect of CKR-2432 on Adhesive Formulations

Film Composition	EHBN (%)*	80	80	90	90
	EDBC (%)*	10	20	5	10
	CKR-2432 (%)*	10	0	5	0
Test Results	Adhesion (ounces/inch)	42	44	46	42
	Creep (mm)	3	fell off	4	fell off
	Tack	high	high	high	high
	Mobility	moderate	soft	firm	soft

*Based on solids.

Figure 4—Power Factor of Polyvinyl Ethyl Ether Compared to PVC and Polyethylene Compounds

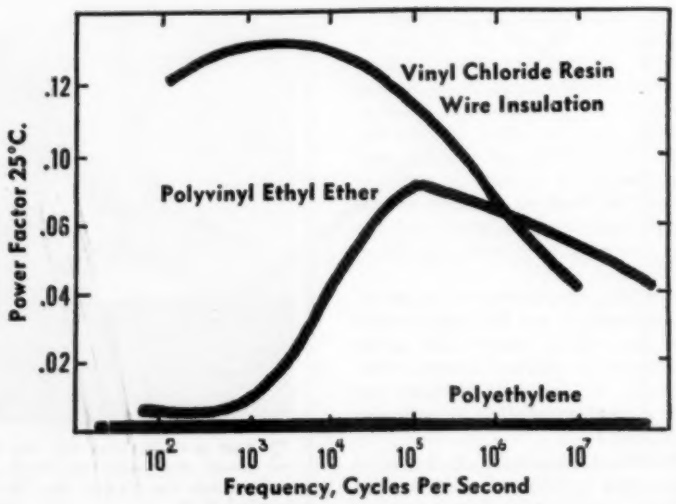


Figure 4, it is shown that the power factor for vinyl alkyl ether polymers lies between those of polyethylene and vinyl chloride resins, being excellent at low frequencies, but only equaling that of the polyvinyl chloride at 10^6 cycles/second.

The vinyl ethyl ether resins are soluble in a wide variety of organic solvents, including ketones, esters and alcohols. In practice, toluene, hexane, heptane, mineral spirits and other low cost petroleum fractions are commonly used.

Choosing Solvent

Viscosity of the polymers in different solvents varies, and in some applications this may be an important factor in choice of solvent. For example, a 25 per cent solution of a high viscosity vinyl ethyl ether resin in heptane has approximately the same viscosity as an 18 per cent solution of the same material in toluene.

In bulk form the vinyl alkyl ether polymers exhibit excellent heat and light stability and can be subjected to long storage. In film form, stability is good, but for exposure to rigorous conditions the addition of a stabilizer is sometimes desirable. The Bakelite Brand vinyl ethyl ether resins are prestabilized by the addition of monotertiary butyl hydroquinone *(8)*.

In the practical utilization of the vinyl alkyl ether resins, the adhesives formulator has at hand a considerable number of compatible materials for property modification. To begin with, he has control of the properties of the basic resins, since by blending them, the balance between adhesive and cohesive strength is varied. In Table II, reduced viscosity and plasticity data are given for one series of commercial products.

By varying the relative proportions of Bakelite Resin EDBM or EDBN, high viscosity materials that are tough and rubbery, and Bakelite Resin EDBC, a low viscosity, tacky product, a vinyl ethyl ether resin base can be obtained with the desired balance of properties.

The proportions of the two resins used will depend upon the ultimate application of the product. One of the advantages of the pressure-sensitive class of adhesives is that bonded surfaces may be parted with some degree of ease. If the application requires this feature, and the bonding is to be temporary, higher proportions of the tacky EDBC resin can be used than if the bonding is to be permanent. Generally, the con-

centration of EDBC in a formulation should not be in excess of 20 per cent.

Modification of the base resin will again depend upon the intended application. For bonding wall or counter coverings, high cohesive strength is needed. An SBR rubber, for example, Naugapole 1022,[1] can be used to increase nerve quality which is a measure of cohesive strength. From 5 to 20 per cent may be included in the formulation. For further adjustment of tack or adhesive strength, the proportion of the Bakelite Resin EDBC may be increased, or additives such as Staybelite Ester No. 10[2] or Piccolyte S-125[3] can be included in the formulation.

Exceptionally high resistance to creep is afforded by the use of a novalac phenolic resin[4] with either of the two high viscosity poly vinyl ethyl ethers. Recent studies disclosed a strong synergistic effect between these materials, that appears to result from an association reaction. Interestingly enough, while increasing creep resistance, the phenolic resin does not perceptively reduce the tack of compositions in which it is included.

Film Properties

Suggested take-off formulations along with properties of adhesive films prepared with them are shown in Table III. For comparison equivalent formulations without the inclusion of the phenolic resin are shown.

In applications where tapes or coverings are to be temporarily bonded, a minimum of adhesive transfer is necessary. Transfer is a function of several factors. A matte-surfaced backing material or carrier permits the formation of a better mechanical bond with the adhesive than a glossy material, and as a consequence allows less transfer of adhesive from it. Backing may be primed to provide a better bond between it and the pressure-sensitive adhesive. The nature of the adherend is also important—if it should be more receptive towards the pressure sensitive adhesive than the carrier, some transfer would be almost inevitable.

In compounding the vinyl ethyl ether adhesives, the usual blenders and mixing tanks can be used for solution mixing. The solution-free forms can be blended on two-roll mills and used for extrusion coating. It is recommended that cooling water be run through the rolls during the operation.

Various materials have been extrusion laminated—cellulose acetate to kraft paper and to polyester films, cellophane to parchment etc.

Continuous films of Bakelite Resin EDBM and EDBN as thin as 1 mil have been extruded without tearing. Compound temperature is critical and must be determined for the individual formulation. The correct temperature will be somewhere in the neighborhood of 280°F. to 330°F.

Some End Products

Adhesive products based on the vinyl ethyl ether resins are successfully used with a broad range of materials; for example, cloth, paper, cellophane, polyester, vinyl, and other flexible materials, as well as rigid products such as ceramics, wood, and plaster.

The nature of their application varies equally widely. In machine shops and other metal fabricating plants, these adhesives are used as temporary bonds between mating pieces to be drilled and tapped or otherwise permanently fastened. As a "third-hand," they maintain the pieces in perfect registration. At the other extreme, they are used to adhere vinyl coverings to walls and counters, and to hold them securely to these surfaces for an unlimited period of time.

The vinyl ethyl ether resins in combination with the many compatible modifying agents available offer an extremely versatile source of pressure-sensitive adhesive products. Their applications are widespread today, and current development work promises an even greater array of uses for the future.

Notes: [1]Product of Naugatuck Chemical Co. [2]Product of Hercules Powder Co. [3]Product of Pennsylvania Industrial Corp. [4]Bakelite CKR-2432.

Literature References

(1) De Bell, *et al*, German Plastics Practice, De Bell and Richardson, Springfield, Mass., (1946).
(2) Dienes, G. J., *J. Colloid Sci.* Vol. 2, 131 (1947).
(3) Favorsky, A., *J. prakt, Chem.* Vol. 44, 208 (1891).
(4) Mosley, S. A., U. S. Pat. 2,549,921.
(5) Reppe, W., U. S. Pat. 1,941,108.
(6) Reppe, W., U. S. Pat. 1,959,927.
(7) Reppe, W., and O. Schlichting, U. S. Pats. 2,104,100,-101,-102.
(8) Rife, H. M. and Walker, A. H., U. S. Pat. 2,922,778.
(9) Schildknecht, C. E., *et al*, *Ind. and Eng. Chem.* Vol. 40, 2104 (1948).
(10) Union Carbide Plastics Company research data.
(11) Wislicenus, *J. Ann.* 106 (1878).

About the Authors . . .

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Pigmented Adhesive Bonds Clear Plastic Film to Continuous Coil Steel

Recently developed technique uses epoxy-based adhesives to bond plastic to steel and to provide a base for the wide range of pigments used in making decorated metal

A recently developed process for bonding decorative plastic coatings to continuous coils of strip steel uses an adhesive which doubles as the vehicle for the base color of the decorative pattern. The technique, developed by National Steel Corp., Pittsburgh, Penna., has cut production costs by eliminating a material and a procedure that are parts of conventional coating methods.

Standard cut sheet coating processes use a clear plastic film which is underprinted and then backed with a colored base coat. The sandwich formed with the printing as the base coat is then adhesive-bonded to the sheet metal.

In the National Steel product, an unbacked and printed clear plastic of the polyester type is used. Pigment is added to the adhesive which bonds the plastic to the steel. This part of the process required the development of a special family of epoxy-based adhesives compatible with the pigments which supply a color base for the pattern. Into the formulation goes a special ingredient —which National Steel does not desire to identify—to provide for glossy or dull finishes.

The coil coating process itself is as follows:

At the start of the production line, a two-mile coil of steel weighing ten tons is lift-trucked onto a coil ramp which feeds either one of two tandem uncoilers so that there are no breaks in production. As the end of a coil already being processed nears, the starting end of the new coil is joined to it by a double-seam.

The new coil of steel then enters into a five-tank washing, treating and drying section. Tank One contains an alkali cleaner; Tank Two a hot water rinse; Tank Three a metal treating pressure spray and immersion; Tank Four a room-temperature water rinse; and Tank Five a chromic acid rinse.

Metal Preparation

Equipment in this metal preparation section includes stainless steel jet nozzles and squeegee rolls located immediately following each tank. Solution heating, where necessary, is done by coil plate-type immersion heaters using steam as a heat source.

Solutions are pumped to individual tank sections from 1000-gallon tanks equipped with dividers. This makes it possible for "return pumps" to push solutions in one side of a divider to the exit side of the tank where they are again pumped back into the metal preparation section. During this action, ample time elapses for settling and filtering.

Solution temperature is controlled by recording-control pyrometers which activate solenoid valve controls at the temperature source. Solutions are titrated every 15 minutes, and detailed records kept of the findings.

From the five-tank preparation section the coil travels through a vertical dryer where all traces of moisture are removed. Then it is ready for pre-heating prior to coating. Pre-heating is a key element in the over-all process because it determines the ultimate bond and the quality of the coating's gloss and texture. In addition, it serves the function of partially curing the metal for coating "from the inside out."

While the strip steel is going through the five-step preparation described, the plastic coating is being pre-heated in heaters along the line. These heating units are located within a foot of the liquid-metal contact point. Rigidly controlled temperatures are maintained to insure coating under perfect viscosity control—with the use of less solvent or volatile material. Actually, the heat of the metal results in a substantial dissipation of solvents before a "skin" is formed over the surface.

Now the metal is ready to flow into a composite, two-unit oven. It travels through this dual-oven at a curing temperature of 300° to 600°F., depending on the gage of the metal and the speed of the processing operation. Just prior to being subjected to this "curing" the coil flows by two applicators which apply

a coating to both sides of the metal at the same time. This "both-sides" coating is generally done in the same color and in the same thickness. It may, however, be done in different colors and in different thicknesses, depending on the customer's requirements.

On the decorative surface, a newly developed adhesive is applied, while the reverse side gets a protective or protective-decorative coating —again, this will depend on the customer's specifications.

Reverse Side Cured

When the coil comes from the dual-oven, the protective coating on the reverse side is already cured. However the adhesive-pigment coating on the decorative side is "tacky" in preparation for the application of the plastic decorative film. This film is fed from immediately below the dual-oven to pressure rolls.

As has been pointed out, the surfacing decorative film is a non-oriented, polyester type material. It may be used clear or as a printed film with any type of decorative pattern that can be photographed. The final finish is dependent for color upon the pigmented adhesive applied earlier in the process.

As soon as the continuous coil leaves the pressure roller which has applied the plastic film, it passes into the cooling section. In this section, the metal—which may be at a temperature of 350°F. or higher—is "shocked" to a temperature just below freezing. This part of the process is extremely important to the bonding and setting of the plastic surface and is the final operation in the process.

The pre-decorated continuous coils of strip steel can be deepdrawn, lock seamed, roll formed, sheared, crimped, bent or pierced. Cup tests to determine the product's allowable severity failed to break the decorative film even after the failure of the steel.

At present, joining is by mechanical means such as fasteners and crimping; however, new heat joining methods and adhesives are being explored.

An important discovery leading to the development of the continuous coil process was made a few years ago by Di-Noc Chemical Arts, Inc., Cleveland, Ohio, supplier of the decorative plastic film. Di-Noc learned how to apply the plastic in liquid form to a paper web. On this paper web, a fine photographic film is laid in such a way as to create a single film for decorative application to metal.

The plastic film is unusual because of its criss-cross molecular structure and because it does *not* have a "memory." The tendency of many plastics to have a memory bars their use in end-product manufacture where "shrink back" ruins the effectiveness of fabricating and forming machinery for accomplishing design objectives.

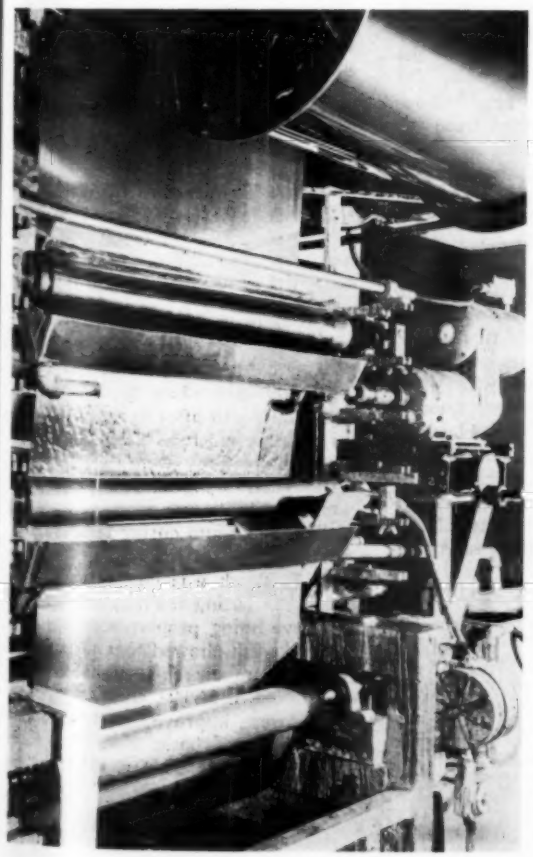
National Steel executives feel that the new continuous coil pre-decorated steel will open up broad new areas in hundreds of end-product industries. Among the reasons given which are thought to enable the product to contribute towards higher quality and appearance standards at substantially lower production costs are:

(1) Feeding end-product manufacturing equipment from continuous rolls will eliminate hand feeding without changes in existing tooling.

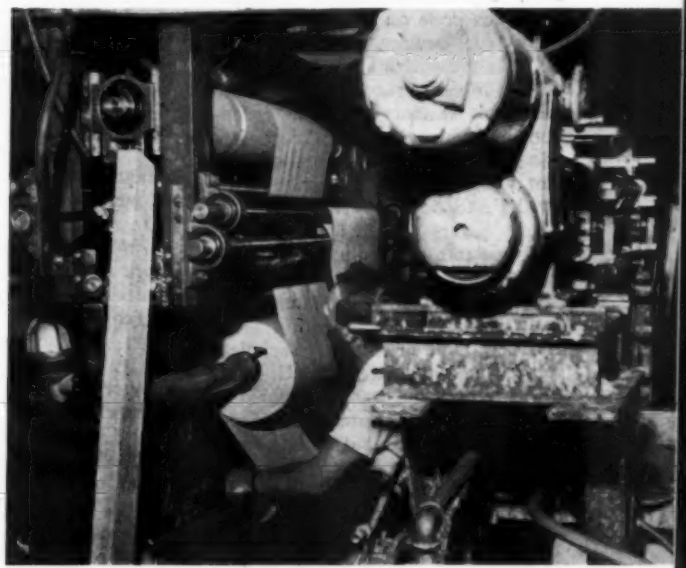
(2) Though pre-decorated, the metal can be subjected to the same forming operations as un-coated steel. This will eliminate the need for the manufacturer to sub-contract or engage in painting and finishing steps.

(3) The ability of the new steel to be pre-decorated in any pattern that can be photographed — wood grains, leather, marble and other special effect patterns.

(4) Protection of the surface by a coat of transparent, polyester plastic coating.



Application of the reverse coating is shown in the photo on left. Below, the plastic film is applied to adhesive-coated steel from continuous rolls with a protective paper backing.



Aircraft Sealants

Researchers at Wright Air Development Division have been investigating a variety of materials for use in fuel tank and cabin sealing operations

By PHILIP A. HOUSE
Materials Laboratory
Wright Air Development Center

The Air Force has been investigating new integral fuel tank and cabin pressurization sealants for use in extreme environmental conditions imposed by advance design aircraft and missiles. The work which has been conducted by the Materials Laboratory both internally and through a contract at the Products Research Company has significantly advanced the state-of-the-art.

The goals for the fuel tank sealants are materials that will withstand fuel and air aging at 450°F. for long periods of time, and aging up to 700°F. for shorter periods. Other work is being done to develop fuel tank sealants that will withstand a nuclear radiation environment up to 1 x 10" ergs/g. DC and still remain capable of sealing. Further work was done on sealants for high energy fuel environments.

Cabin pressurization sealants have much the same requirements as the fuel tank sealants with the exception of fuel resistance. Work has also been initiated for cabin sealants that will withstand temperatures of 1000°F. to 1500°F. However, this article covers progress on the fuel tank sealants only. Numbers identifying sealants and primers have been assigned by Products Research Company and more detailed information can be found in WADC Technical Report 58-89 Parts I and II.

An integral fuel tank is defined as basic airframe structure designed and fabricated to be fluid tight. There are no bladder cells and fuel is in direct contact with the structure. There are three types of sealants that will be described. They are filleting, fill and drain, and groove sealants.

Filleting sealants are high solids, putty-like materials laid along the seams and edges of reinforcing members in the airframe structure. They are also used to seal bolts and rivets. Presently used materials are polysulfides that can be applied and cured at room temperature.

Fill and drain sealants are low solids materials and derive their name from the application of filling the tank with the material and draining it out, thus leaving a thin film over the entire tank. The sealant can also be brushed and sprayed. Presently used materials are based on buna-N-phenolic resin blends and are designed to provide protection against fuel for the filleting sealants and corrosion protection for the metal.

Groove sealants are very viscous materials that are injected from the outside of an aircraft wing with high pressure injection equipment into a groove cut in one of two mating surfaces. Polysulfide is presently used for groove sealants. The sealant is unique in that it does not cure and so new material can be injected into the groove to prevent fuel leaks.

Filleting Sealants—Most of the work on the investigation of filleting materials has been done with Viton A (copolymer of vinylidene fluoride and hexafluoropropylene) because of its resistance to fuel and high temperature and its ability to be compounded into a useable consistency. The first fairly successful material that was developed was designated as H-29:

Ingredients	*Parts by Weight*
Viton A	100
Dyphos	8
Protox 166	8
Zinc Chromate (M2105/538)	40
Philblack A	10
Flexol TOF	6
MEK	42

Eight parts by weight of ten per cent hexamethylene diamine in methyl ethyl ketone was the curing agent.

Primers are used to provide proper adhesion. Two of the best primers are R-28, which is Chemlok 607; and R-32, shown below.

Ingredients	*Parts by Weight*
Viton A	100
Maglite D	100
Philblack A	20
HMDA-C	1.3
MEK	774

Both single primers and double primers are used. The primers are applied and baked for 15 minutes at 250°F. The sealant is then applied and cured by several different curing cycles. Typical of such a curing cycle is:

Room Temperature	for 3 days
120°F.	for 1 day
150°F.	for 1 day
200°F.	for 1 day
350°F.	for 2 hours

The curing at 350°F. was necessary to develop adequate adhesion.

This compound was able to retain peel strengths close to 20 pounds per inch width after aging at 450°F. in both air and fuel. Tensile strength and elongation were satisfactory after such aging and low temperature flexibility was good.

The maximum curing temperature that could be tolerated, however, was 250°F. Work was continued to reduce the curing temperature and to improve aging properties.

The work showed that the curing temperature could be reduced to a maximum of 250°F. and aging properties were improved. It was found that a more basic zinc chromate than previously used gave a higher

state of cure and thus greater heat resistance. Therefore, the zinc chromate was replaced by the even more basic lead chromate. The optimum compound was found to be H-52-6:

Ingredients	*Parts by Weight*
Viton A	100
Dyphos	8
Protox 166	8
Lead Chromate No. 501	40
Philblack A	10
Flexol TOF	6
MEK	43

Six parts by weight of ten per cent hexamethylene diamine in methyl ethyl ketone was the curing agent.

The lead chromate No. 501 is no longer available. It has been replaced by lead chromate No. 5563 without any apparent change in properties.

After application and baking of the primers the sealant is applied and subjected to the approximate following cure cycle:

R.T.	for 1 day
120°F.	for 1 day
150°F.	for 1 day
160°F.	for 3 days
212°F.	for 1 hour
250°F.	for 1 hour

Properties that have been obtained with this material are shown in Table I. It should be noted that all results were not obtained on the same batch of material.

Fill and Drain Sealants — The work conducted on the fill and drain sealants was also mostly confined to Viton A. Initial efforts were directed toward study of a one-part material but compounds containing curing agents would either gel in a few days or would fail to cure. This approach was therefore abandoned.

A two-part compound has been developed that exhibits very good properties after high temperature aging in both fuel and air. This compound is designated as G-59:

Ingredients	*Parts by Weight*
Viton A	100
Sil Stone 120	25
Maglite D	15
MIBK	400

This material requires a primer, P-53, to develop adequate adhesion:

Ingredients	*Parts by Weight*
Viton A	2
Durex 11078	2
BRL 2741	2
MEK	94

There are two methods available for applying the sealant. In both

Table I—Properties of H-52-6 Filleting Sealant

Aging Conditions	*Tensile Strength (psi)*	*Elongation (%)*
Initial	800	325
24 hr./450°F.	1510	260
168 hr./450°F./JP-5	1050	230
72 hr./550°F./JP-5	980	140
	Weight Loss (%)	
29 days/450°F.	10.7	
22 days/500°F.	15.8	
	Peel Strength (lbs./in.)	
	Stainless Steel	*Titanium*
Initial	35	30
72 hr./450°F./JP-5	30	25
172 hr./450°F./JP-5	20	18
10 hr./600°F./JP-5	22	12
10 hr./650°F./JP-5	0	0
1 hr./650°F.	5	15
1 hr./675°F.	5	10

Figure 1—Channel Sealant Jigs and Injection Gun

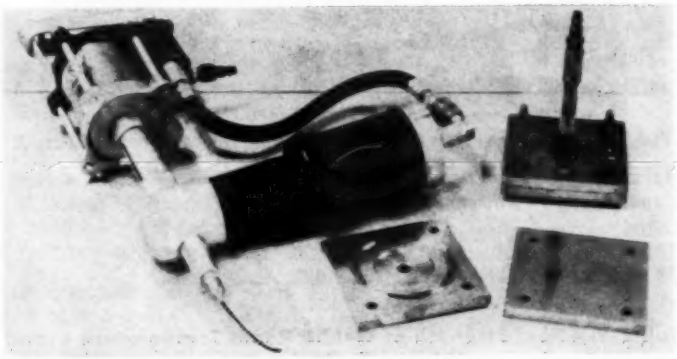


Table II—Properties of G-59 Fill and Drain Sealant

Aging Conditions	*Tensile Strength (psi)*	*Elongation (%)*
Initial	1590	720
42 hr./450°F./JP-5	1330	450
21 days/450°F.	1400	100
210 hr./500°F.	1230	100
10 hr./600°F./JP-5	670	620
10 hr./650°F./JP-5	400	470
10 hr./675°F./JP-5	380	390
10 hr./700°F./JP-5	80	530
	Peel Strength (lbs./in.)	
	Stainless Steel	*Titanium*
Initial	41	36
7 days/140°F./3% Salt Solution	—	22
7 days/450°F./JP-5	—	19
14 days/450°F.	—	19
65 hr./550°F./JP-5	—	9
10 hr./600°F./JP-5	19	24
1 hr./650°F.	26	23
10 hr./650°F./JP-5	14	16
1 hr./675°F.	14	11
10 hr./675°F./JP-5	8	7
1 hr./700°F.	2	2
10 hr./700°F./JP-5	10	5

Table III—Pressure Rupture Test on C-37 Groove Sealant

Aging Conditions	*Tested in Oil at*	*Leakage*
96 hr./270°F./JP-4	350°F.	No leakage at 30 lbs. air for 30 minutes
Jig rinsed of oil	75°F.	No leakage to 20 lbs. air. Leaks rapidly at 20 lbs.
96 hr./250°F./JP-4 then 48 hr./450°F	350°F.	No leakage at 30 lbs. air for 30 minutes
Jig rinsed of oil	75°F.	No leakage to 20 lbs. air. Leaks rapidly at 20 lbs.
15 hr./450°F./JP-5	350°F.	No leakage at 30 lbs. air for 20 minutes
15 hr./450°F./JP-5 then 2 hr./450°F.	350°F.	No leakage at 30 lbs. air for 20 minutes
15 hr./450°F./JP-5	75°F.	No leakage at 30 lbs. air for 20 minutes
15 hr./450°F./JP-5 vapor then 2 hr./450°F.	350°F.	No leakage at 30 lbs. air for 20 minutes
Cooled to 75°F.	75°F.	No leakage to 10 lbs. air. Leaks badly at 10 lbs. air
Heated to 350°F.	350°F.	No leakage at 30 lbs. air for 20 minutes

Table IV—Properties of Room Temperature Cured Viton A

Aging Conditions	*Tensile Strength (psi)*	*Elongation (%)*	*Hardness (Points)*	*Volume Change (%)*
Initial	1500	700	57	
70 hr./400°F./JP-4	1800	550	53	+7
70 hr./500°F.	1450	320	65	−13

Table V—Peel Strength of G-129 Room Temperature Cured Fill and Drain Sealant

	Peel Strength (lbs./in.)	
Aging Conditions	*Stainless Steel*	*Titanium*
Initial	18	30
7 days/140°F./3% salt solution	24	13
14 days/450°F.	35	27
7 days/450°F./JP-5	30	25

Table VI—Properties of H-57 Filleting Sealant

Aging Conditions	*Tensile Strength (psi)*	*Elongation (%)*
Initial	1040	475
168 hr./450°F.	1380	245
72 hr./500°F./JP-5	1430	375
72 hr./550°F./JP-5	845	275
	Peel Strength (lbs./in.)	
	Stainless Steel	*Titanium*
Initial	24	45
72 hr./550°F./JP-5	10	16

cases the primer is applied and baked two hours at 250°F. The first method uses as the curing agent 1.2 parts per 100 parts Viton A of hexamethylene diamine in isopropyl alcohol. The curing agent is added to the sealant, the sealant applied, dried 16 hours at room temperature, and baked one hour at 250°F. This method does not lend itself to a fill and drain application since a great deal of material would be wasted.

The second method is adaptable to the fill and drain method. It consists of filling a tank with the compound minus the curing agent, draining, and drying two hours at room temperature. The tank is then filled with a two per cent solution of hexamethylene diamine in isopropyl alcohol for two hours at 120° F. The curing agent is drained, the tank dried for 16 hours at room temperature, and then baked one hour at 250°F.

Comparison of Results

Test results that have been obtained using the first method for cure are shown in Table II. Results using the second method for cure are similar. It is pointed out that all results were not obtained on the same batch of material.

Groove Sealants—Viton A, Kel-F Elastomer 3700, and 3M Brand Fluoro-Rubber 1F4 were first studied for use as a groove sealant. High temperature plasticizers such as Kel-F oil were used to obtain a workable consistency. It was found, however, that the materials had no adhesion to metals and upon heat aging became hard and crumbly.

A fluoro-silicone rubber, Silastic LS-53, was then investigated. Originally the material was furnished with curing agent, so, hydroquinone was used to neutralize the curing agent. Later, LS-53 was made available without the curing agent.

Reverts to Liquid

It was discovered that heating the LS-53 for 16 to 48 hours at 450°F. in a closed container caused it to revert to a liquid. The reversion eliminated LS-53 as a groove sealant in itself but brought up the possibility of using it in the reverted condition as a plasticizer for other materials. The reverted LS-53 was not sufficiently compatible with Viton A or Kel-F 3700 but was compatible with Fluoro-Rubber 1F4. A compounding study was made and the optimum compound was found to be C-37:

Ingredients	*Parts by Weight*
Fluoro silicone rubber LS-53U (reverted)	100
Fluoro-Rubber 1F4	44
MT Carbon Black	53

The test jig that was most used to evaluate the groove sealants is shown in Figure I along with the injection gun. The inside dimension of the groove is 3" and the groove is ¼" across, 0.070" deep and contains four injection holes. There is ½" land on both sides of the groove and provision for attaching an air hose for application of air pressure. Re-injection and pressure retention properties are evaluated after subjection to various fuel and dry air agings. Some results on C-37 are shown in Table III.

Other tests have been conducted on this groove sealant such as low temperature flexibility, corrosion, adhesion, weight loss, and thermal extrusion. Only in the case of adhesion has the compound not quite met desired properties. Though 100 per cent cohesive failure is desired, the compound exhibits an average of approximately 50 per cent cohesive failure. The temperature limit for C-37 has been determined as 48 hours at 450°F.

A one-part filleting sealant supplied by Dow Corning Corporation was recently evaluated by Wright Air Development Center. It was a fuel resistant silicone rubber furnished in sealed polyethylene tubes ready for extrusion in the standard sealant gun. A room temperature drying primer is used for adhesion and the sealant obtains sufficient cure in seven to fourteen days at room temperature.

The material withstood thermal shock up to 400°F. and thermal rupture up to 350°F. after immersion in fuel. Unfortunately, it exhibited very low tear strength after fuel immersion and no adhesion after immersion in water. The sealant remains very interesting, however, since mixing is not required and it will cure at room temperature.

Notes: Viton A is the trade-mark of E. I. du Pont de Nemours and Co. Viton A HV is a higher viscosity version of Viton A. Chemlok 607 is the trademark of Lord Mfg. Co. Durez 11078 is a product of Hooker Electrochemical Co. BRL 2741 is a product of Bakelite Corp. Kel-F Elastomer 3700, the registered trade-mark of Minnesota Mining & Mfg. Co., is a copolymer of vinylidene fluoride and chlorotrifluoroethylene. 3M Brand Fluoro-Rubber 1F4 is a product of Minnesota Mining & Mfg. Co. Silastic LS-53 is the registered trade-mark of Dow Corning Corp.

Recently, a method was developed by the Materials Laboratory, Wright Air Development Center, for curing selected fluoroelastomers at room temperature. Such a curing system is directly applicable to the sealant field. As yet, all adhesion problems have not been solved. When they are, it should be possible to obtain 500°F. to 600°F. service using application techniques similar to those used today.

Viton A was used for the compounding study. The following ingredients were milled on a standard laboratory rubber mill:

Ingredients	*Parts by Weight*
Viton A	100
MT Carbon Black	30
Magnesium Oxide (C.P.)	10
Diallylamine	1.0

The stock was placed in a mold and heated in a hydraulic press for two hours at 300°F. After heating, the material was dissolved in an equal amount by weight of methyl ethyl ketone. Other amounts of solvent can be used depending on desired consistency. The curing agent used for the sealant was:

Hexamethylene dithiol	1.05
Tri-n-amylamine	0.5

Hexamethylene dithiol is the cross linking agent and the tri-n-amylamine and moisture are catalysts.

Other materials such as amines will crosslink the sealant, however, and a material was needed that would not continue to crosslink at high temperature. Hexamethylene dithiol is such a material. Glycol dimercaptoacetate is another such material and is more readily available.

The physical properties shown in Table IV were obtained on this compound cured seven days at room temperature. This work is reported in WADC Technical Report 59-42.

A fill and drain sealant, G-129, has been prepared using this curing system:

Ingredients	*Parts by Weight*
Viton A HV	100
MT Carbon Black	30
Maglite D	10
Diallylamine	1.0
MIBK	350
Curing Agent	
Hexamethylene dithiol	1.5
Tri-n-amylamine	0.5
MEK	13.0

The previously mentioned fill and drain primer was applied to stainless steel and titanium and baked two hours at 250°F. The sealant was then applied and cured seven days at room temperature. Adhesion results are shown in Table V.

A filleting sealant, H-57, has also been prepared.

Ingredients	*Parts by Weight*
Viton A	100
MT Carbon Black	30
Maglite D	10
Diallylamine	1
MEK	47
Curing Agent	
Hexamethylene dithiol	1.5
Tri-n-amylamine	0.5
MEK	6.0

Properties obtained with this formulation are shown in Table VI. Cure conditions were 48 hours at room temperature followed by 48 hours at 120°F. The previously mentioned primers for filleting sealants were used on the peel strength panels.

The compounding study of sealing compounds using this new room temperature system has only been started but it has been proven that sealing compounds can be formulated. There is no sponging, tensile strength and elongation properties remain high, and adhesion is good after subjection to air and fuel aging at elevated temperatures. As yet, a heat cured primer is necessary but such a primer could be applied to detail parts before assembly and perhaps further study will eliminate this problem.

This is the work that has been accomplished on fuel tank sealants by the Air Force. All of these materials are available and some have been furnished to airframe manufacturers for evaluation. The dithiol cured materials have not been furnished, but they will be in the near future. It is hoped that these materials will go a long way toward solving the problems encountered in sealing fuel tanks of advance design aircraft and missiles.

About the Author . . .

PHILIP A. HOUSE is a materials engineer in the Elastomers Section, Non-Metallic Materials Division, Materials Laboratory, WADD. For the last three years he has specialized in research on fuel tank sealing compounds.

Some Tips on Hot Plate Pressing of Glued Veneers

Practical hints on the prevention of discoloration in face veneeers, how to compensate for uneven surfaces, the safe removal of veneer tapes and the proper loading and unloading of plant presses

Because the steel platens of hot plate presses are heated by steam, they are never completely proof against rust, even though extreme care may be employed to keep them clean. Use of aluminum cauls completely prevents any discoloration of thin face veneers from rust, which might otherwise be picked up from the press plates.

It is good practice to protect even thick face veneers from discoloration this way. This is in spite of the fact that where thicker veneers are used for plywood faces, they will stand considerable additional sanding and generally allow any discoloration which might occur to be removed in subsequent smoothing.

Protection against discoloration by press platens is really the chief reason for using aluminum cauls, though there are several other equally important factors involved.

Most face veneers today are joined together by gluing their edges directly with some type of modern splicing machine. Nevertheless, some veneers are still taped together; this is especially true of fancy matched veneers. Where face veneers which have been taped together are laid up in panels and processed through a hot plate press, the paper tape will be pressed into the panel surface to a degree not experienced in cold-pressing operations. If the extent to which tape itself may compress during the hot plate pressing operation is ignored, the tape will be pressed into the wood its full thickness.

This is one disadvantage of obtaining a perfectly level surface at the hot plate press. Where face veneers are thin, forcing the top surface of veneer tape flush with the panel surface can give rise to important handicaps at the subsequent sanding operation. In attempting to sand out all the tape and glue, there is always the possibility of sanding through the veneer face adjacent to the tape.

One method for reducing such trouble is to draw a dampened sponge along the length of each piece of tape immediately after panels come from the hot press. Resident heat and moisture act together, raising the compressed wood fibers beneath the tape to some extent. As a result, the tape is partially lifted above the wood fibers, making it easier to sand off cleanly with less danger of cutting through veneer.

Thickness Variations

Thin wood cauls are occasionally used in hot plate pressing to compensate for thickness variations. This is especially true practiced where matched veneer faces of different wood species are taped together for hot pressing.

Generally speaking all veneers used in hot press panels should be made of uniform thickness as far as possible. However, where veneers of different woods are joined, they often cannot be held exceptionally close. In many cases, this can be compensated for in considerable degree by using very thin cauls of basswood veneer.

Using a resin-type glue, basswood veneers are preliminarily made up into exceptionally-thin, three-ply panels for this purpose. Afterward, these pieces of basswood plywood are placed between the matched-veneer faces and the steam plates of the press, using them instead of aluminum or other cauls.

Basswood has peculiar characteristics. One of these is that it is springy, incorporating a certain resiliency. This allows it to retreat, thickness-wise, under excessive pressure. It has the facility of retreating most where pressure is greatest; this, of course, corresponds to any point where face veneers are thickest.

Therefore, when basswood cauls are used in the manner cited, and pressure is building up strongly on portions of a matched-up veneer face which are a little thicker than other parts, resiliency in the basswood caul causes it to yield and absorb at least a part of this difference.

Obviously, basswood cauls used in this way must be made as thin as possible. Only thus can the heat from the plate penetrate through both the caul and the underlying face veneer in a reasonable period of time, striking through to the glue line.

Different kinds of layouts are found on high-production hot plate press operations. On such work, the particular type of press used has much to do with facilities employed for immediate tasks between the glue spreader and the press. These consist of laying up press loads in advance, loading them into the press, etc. Somewhat higher atmospheric

temperatures are common where hot pressing glues are used. Such adhesives are less critical in regard to assembly time than cold-press glues, because the latter are provided with catalysts which make them suitable for room-temperature setting.

Regardless of this, different adhesives used in hot plate pressing have their variables. Therefore, it is necessary for the operator of a hot plate press, or the man supervising its operation, to be completely familiar with all assembly-time characteristics of any particular bondant being employed. This enables him to develop a hot plate press schedule which will harmonize to best advantage with characteristics of the glue.

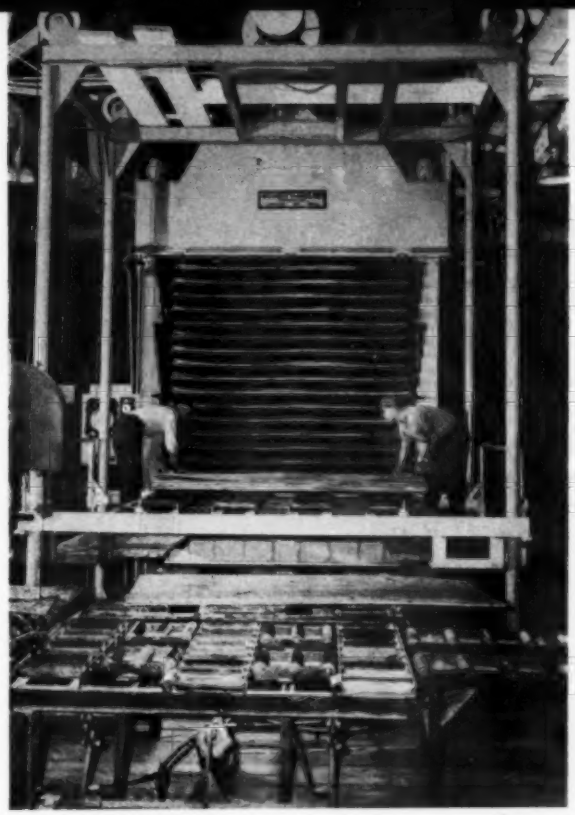
Where a battery of hot plate presses is employed, two glue spreaders are sometimes used for each press in the battery. Such a layout is based on each spreader providing half of each press load. Using such a system, a sizable area must often be reserved between spreaders and press for enough material to be kept spread in advance so that press production can proceed without interruption. Adequate glue-spreader capacity is particularly important when the adhesive being used requires a minimum amount of assembly time before pressing.

If one considers a bondant which requires at least an hour of assembly time, and in connection with it, one is proceeding on the basis of a ten-minute complete press cycle, it is obviously necessary to have room between spreaders and presses for six loads of material. Otherwise, an hour of assembly time could not be provided.

In many plants, as soon as a press load has been fully spread and laid up, a time notation is written on top of the load. Depending upon predetermination of the system employed, such a notation may either be made at the time layout of the load was completed, or it may be a future time, obtained by adding required *minimum* assembly time to time already elapsed.

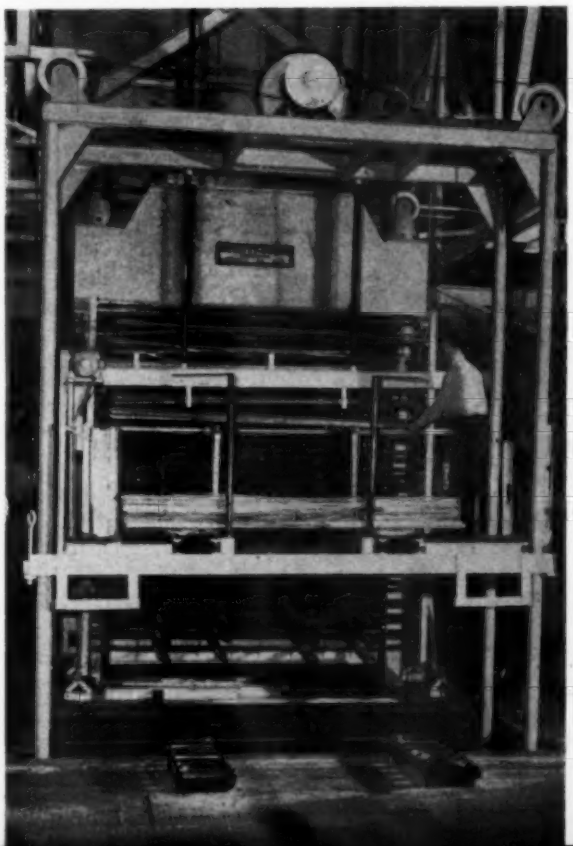
Writing time on tops of different loads has the additional advantage that loads will go to press in their proper consecutive order—as spread. In this way, each will have approximately the same assembly time. Obviously, marking the time down insures that no batch of material will enter the press before the proper time.

Differences are found in the design of hot plate presses working in



Infeed side of Merritt-Solem 20-opening hot plate press being loaded at Menasha Sales Corp., North Bend, Ore. Note special roller conveyor equipment in the foreground.

Outfeed side of same press. Pressed panels are being received on a lift which will then be lowered to a point where package can be shunted onto roller equipment.



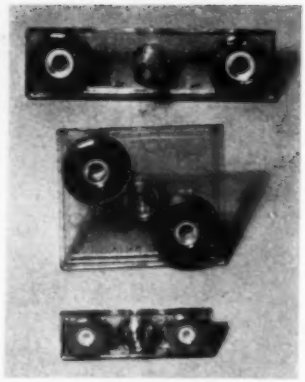
various locations. One reason is that different press manufacturers have their own ideas about design. Practically all such presses are hydraulic; they may be either end-opening or side-opening machines.

Merrit-Solem, for example, makes side-opening machines, of very heavy design, with a fabricated steel head and base, tied together with alloy steel strain rods. The main lifting and pressing cylinders are mounted in the base, and the hydraulic pumping unit is located at one end of the press, with the control panel mounted on the press itself. The hydraulic rams are of ground and polished alloy steel, and are amply guided to insure perfect alignment during operation. The main cylinders are steel castings, and all stuffing boxes are outside packed. Packings employed are multiple-chevron type and are supported at top and bottom by bronze glands, machined to fit the packing rings. The top glands are secured by steel gland rings, bolted to the cylinder, with provision for compensating for packing wear in service.

Methods of loading and unloading vary with the plant, and depend on the volume a given press must produce, as well as other factors. Sometimes, special auxiliary press loaders are employed. In many cases, however, other special handling equipment is used between spreader and press. This equipment generally incorporates transfer roll system and a lift at the press infeed. A package of laid-up panels, which have already been through the glue spreader and through any necessary intermediate assembly time, is placed on the lift. This package contains just enough panels to fill the openings in the hot plate press.

Usually, where a large press is involved, the lift is arranged to raise and lower two men along with the package of panels so that they can load it with the highest degree of facility. In loading, the lift raises the package and the men to a level suited for placing the panel in the top opening, and lowers them progressively while they charge opening after opening on the way down. In this way, they are at the bottom and ready to retreat when all panels are in place.

Often, a second (offbearing) lift is provided at the outfeed side of the press. The bonded panels are received on this lift which lowers them to the floor in a package, ready to be carried away by fork truck, or over a suitable conveyor, to subsequent sizing operations.



Plastic sealed cell terminal posts such as those shown above were bonded (right) by applying epoxy to the posts. The plastic cone directs adhesive flow.

Epoxy-Sealed Cells

A modified epoxy adhesive has helped solve an important problem in the design and production of cells for batteries manufactured by Yardney Electric Corp., New York, New York.

Pioneers in the development and manufacture of silver-zinc and silver-cadmium battery systems, Yardney Electric has long been concerned with the perfection of a method for sealing the metal cell terminal posts into the injection molded plastic covers of cell cases. Company engineers point out that the problem was complicated by the fact that the adhesive chosen would not only have to be able to bond the plastic cover and the silver-plated steel terminals, but would have to possess complete chemical inertness to the potassium hydroxide electrolyte used in the batteries.

After some testing, it was decided to organize the production line setup around the use of Bondmaster M688, a modified epoxy formulation developed by Rubber & Asbestos Corp., Bloomfield, N.J. Yardney personnel reported that they were able to obtain excellent thermal stability and thermal shock resistance with the epoxy compound.

The adhesive is used with a General Mills hardner designated as Versanid. Since the company prefers to formulate the epoxy and hardner in such a ratio that only a 30-minute pot life is possible, it is mixed in small batches to serve immediate production needs. Bonded cells are oven-cured at 110°F. overnight.

Crucial Advantage

An additional but crucial advantage of the modified epoxy is its light weight. For example, the total weight of the adhesive used for a 14-cell, 15 ampere-hour Silvercel battery is only seven grams—out of a total battery weight of 11.5 pounds.

Bondmaster M688 can be formulated for room-temperature cures. Yardney, for example, also uses it as a potting material in primary cells to give them additional vibration protection against shock. In that operation, the compound is allowed to cure at room temperature.

Yardney Silvercel and Silcad batteries are widely used in applications where miniaturization and high power are crucial. Recently, they were incorporated in the new Motorola Portable TV.

Low-Cost Gel-Time Meter

Inexpensive and rugged device using a reservoir of steel-coated BB shot permits fast and accurate determination of resin's application life over a wide temperature range

By **WILLIAM H. CRANDELL**
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One of the more important properties of liquid thermosetting resins is the gel time—the interval required for the resin system to change from a liquid to a gel. Gel time usually differs from the cure time in that the latter is the total time required for the system to develop full strength.

The gel time of a particular system varies directly with its temperature and its mass. The mass is important because there is an exothermic reaction when the systems start to gel. If the mass is increased, the heat developed is dissipated more slowly so that the temperature of the compound increases.

Since the gel time, in general, corresponds closely to the time during which the resin can be successfully applied, it is obvious that it is important to have a method for measuring it accurately. The ideal gel-time meter should be of low initial cost, low upkeep, able to determine gel time over a wide temperature range, rugged and easily cleaned.

The schematic shown here is of an apparatus designed to meet all the foregoing requirements. It has proved to be extremely simple to build, operate and maintain. Its use is recommended to those who work with liquid epoxy resins, liquid polyester resins, liquid phenolic resins and similiar materals.

Basically the low-cost (less than $10) gel-time meter consists of:

(1) A synchronous motor (12 rph is convenient) which can be attached to a mounting block.

(2) A reservoir of spheres.

(3) A delivery tube.

(4) A tapered cone (rubber stopper) used to mount the meter in a hole in the top of an oven or in a ring mounted on a ring stand.

(5) A rotating member with one or more equally-spaced holes to accept spheres. Diameter and depth of each hole is 1/64" greater than the diameter of the sphere. A through hole must be provided for the rotating member in the mounting block.

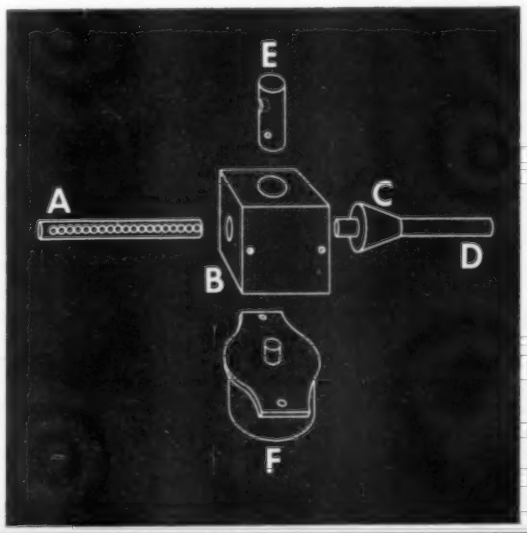
The rotating member is attached to the synchronous motor with a set screw prior to assembly of the motor to the mounting block. The hole for the spheres must line up with the through-hole for the spheres in the mounting block.

The through-hole for the spheres should be counter-bored at either end of the mounting block to accept the tubular reservoir and the delivery tube. Both reservoir and tube are held in place by set screws in the mounting block.

It has been found that copper-coated steel BB shot are excellent for use as the metallic spheres.

To determine gel time with this meter, the meter is placed over the mixed resin in the mixing container either in an oven or at room temperature, depending on the temperature of the test. BB shot is measured into the reservoir, and the meter is started and run until the BB shot no longer sink into the resin. By determining the number of BB's in the resin (total number used, minus those on the top of the resin and those in the reservoir), and the rate at which the BB's are metered into the resin, the gel time can be easily calculated.

By use of synchronous motors of different speeds and/or by varying the number of equally-spaced holes in the periphery of the rotating cylinder, gel times can be measured over a wide range with an accuracy of plus or minus five per cent or better.



Schematic of the gel-timer unit. A—reservoir of spheres; B—mounting block; C—tapered cone; D—delivery tube; E—rotating member; F—motor.

NEWS of the

ADHESIVES WORLD

Annual ASTM Meeting Features Four Papers on Adhesive Bonds

Four papers dealing with testing of adhesive bonds were presented at a Symposium on Shear and Torsion Testing during the 63rd Annual Meeting of the American Society for Testing Materials from June 26 to July 1, in Atlantic City, N.J. The symposium was sponsored by Subcommittee 25 on Shear and Torsion Tests of ASTM Committee E-1 on Methods of Testing.

The papers presented were: "Bonded Metal-to-Metal Shear Testing," by Lee R. Lunsford (Convair); "On the Lap Joint Shear Test for Metal-To-Metal Bonds" and "Preparation of Metal Surfaces for Adhesive Bonding," both papers by Robert S. Shane (General Electric); "Shear and Torsion Tests Used at U.S. Forest Products Laboratory for Wood, Plywood, and Sandwich Constructions," by E. W. Kuenzi and W. G. Youngquist (U.S. Forest Products Laboratory).

Possibility of Error

Mr. Lunsford discussed in detail the factors affecting joint strength, the different specimen types, and the properties actually evaluated by each type. He compared these properties with those of a bonded joint which actually allow failure to take place, pointing out that most methods presently used are empirical, and serious errors could be obtained in extrapolating this information to other materials or environments.

The speaker also discussed the possibilities of predicting joint strength from basic material properties, and revealed some of the difficulties encountered in bonding titanium joints where the adherend strain is approximately twice that of steel or aluminum. Mr. Lunsford remarked that these principles are incorporated into a method of analysis in which the shear modulus of the adhesive becomes very important.

In his paper on the lap joint shear test, Mr. Shane stated that certain modifications were made in the test during studies on the preparation of aluminum, stainless steel, and magnesium surfaces for adhesive bonding. According to the speaker, these modifications resulted in a much smaller than usual—about five per cent of the mean value—standard deviation in the test results. The modifications in the test included: uniform rate of application of stress; improved grips; making of specimens in a jig to assure parallelism of lap components; and cutting of specimens.

Mr. Shane also presented data on the choice of a test adhesive, the effect of parallelism of press platens, the uniformity of heating of press platens, and the effect of location of test coupon within a specimen panel. The speaker pointed out that in determining the types of failure by contact resistance, a specular surface indicates an area of adhesive failure while a dull surface indicates an area of cohesive failure.

In his paper on the preparation of metal surfaces, Mr. Shane indicated satisfactory recipes for the preparation of aluminum, stainless steel, and magnesium for adhesive bonding, and he presented illustrative data to show the reliability of results.

Mr. Kuenzi, in his paper co-authored by Mr. Youngquist, presented a brief description of the test methods used for determining shear characteristics of wood, plywood, adhesives, and sandwich constructions. He traced the history of some of the test methods and discussed their advantages, disadvantages and suitability.

Tests discussed by Mr. Kuenzi were the shear and torsion tests for solid wood; the plate shear, panel shear, rolling shear, and tubular torsion tests for plywood; the plywood glue shear, wood glue joint shear, metal lap joint and torsion test of adhesives for metals, and the shear tests for sandwich constructions and cores. An analysis of the stress conditions in the test specimens was presented for some of the tests.

Underwater Fuel Depot

An experimental underwater storage system that would give the Armed Forces strategically located fuel and supply depots has been installed in the Gulf of Mexico. The system's tanks were made by the Firestone Tire & Rubber Co., Akron, Ohio, for the Jet Fuel & Storage Co. They are nylon-reinforced, can be filled or emptied by tankers, and are interconnected in a series. The interior of the tanks can be coated with different types of synthetic rubber to make them suitable for the storage of a variety of liquids, according to Raymond C. Firestone, president of the rubber firm. The tanks are secured to the ocean floor by means of a bored anchor. The anchor, through a swiveled steel connection, is attached to a "strongback" steel channel on the bottom of the tank.

Nine Present Papers At Plastics Symposium

Quantum Incorporated, Wallingford, Conn., research organization, sponsored a "Plastics in the 'Sixties" symposium on May 19 at the Yankee Silversmith Inn, Wallingford. Speakers and their topics were: J. S. Lunn (Lunn Laminates), "New Horizons in Reinforced Plastics"; D. M. Neely, (Shell Chemical), "The Future of Epoxy Resins in the 'Sixties"; Robert Tomashot, (Wright Air Development), "Present and Future Air Force Developmental Objectives in Reinforced Plastics"; C. C. Thomas, Jr., (Quantum) "Modification of Plastic Properties Through the Utilization of Inorganic Materials."

Also, Dr. F. R. Eirich, (Polytechnic Institute of Brooklyn), "Special Performance Polymers"; Robert Burns, (Materials Advisory Board, National Academy of Sciences, National Research Council), "Plastics in Defense"; M. E. Kripas, (Stanley Chemical), "The Future of Plastisols"; R. M. Clarke, (Joclin Manufacturing), "Structural Reinforced Plastics"; D. P. Shedd (Mobay Products) "The Techniques and Use of Flexible and Rigid Urethane Foams."

New Shawinigan Product

Shawinigan Resins Corp., Springfield, Mass., has announced a newly developed plasticized dispersion of a high viscosity polyvinyl butyral resin. The product, Resin D-566, is said by the company to be useful where a low tack, abrasion resistant, high strength film with high adhesion is required. It can also be combined with water soluble or water dispersible thermosetting resins. Suggested areas of application include aqueous-based baking primers, decorative and protective coatings for metal, wood, glass, and other materials, textile finishing, binder for non-woven fabrics, and grease-proof or washable coatings for paper and textiles.

Lynch Named Agent

Union Carbide Plastics Co., New York, N.Y., has appointed A. J. Lynch and Co. as a distributor in the protective and decorative coatings fields in Southern California and Arizona. Union Carbide products to be distributed by the Lynch organization include vinyl, phenolic and liquid epoxy resins.

1960-1962 officers of ASTM Committee C-24 on Joint Sealants and officers of the committee's three subcommittees. The C-24 officers are, seated left to right: J. R. Panek (Thiokol), secretary; Wayne Koppes (Architectural Consultant), chairman; Roger K. Humke (Minnesota Mining & Mfg.), vice-chairman; H. Kleinhans (Pawling Rubber), membership secretary. Subcommittee officers are, standing left to right: R. W. McKinley (Pittsburgh Plate Glass), chairman, Subcommittee 3 on Preformed Shapes; M. F. Torrence (DuPont), secretary, Subcommittee 3; F. Frybergh (Skidmore, Owings & Merrill), chairman, Subcommittee 2 on Bulk Compounds; H. Lipkind (L. Sonneborn), secretary, Subcommittee 1 on Nomenclature; G. F. Lamb (Construction Specifications Institute), chairman, Subcommittee 1. Not in photograph is J. Amstock (Products Research), secretary, Subcommittee 2.

Committee C-24 Re-elects Officers

ASTM Committee C-24 on Joint Sealants re-elected its slate of officers for 1960-1962 at a meeting held on June 28 during the week-long Annual Meeting of the American Society for Testing Materials in Atlantic City, N.J. Re-elected to serve for a two-year term were: *Chairman*, Wayne Koppes (Architectural Consultant); *Vice-Chairman*, Roger K. Humke (Minnesota Mining & Mfg.); *Secretary*, J. R. Panek (Thiokol); *Membership Secretary*, H. Kleinhans (Pawling Rubber). Re-elected to the executive committee, which consists of the committee officers and two members-at-large, was G. J. McGill (Martin Co.). Elected to the executive committee as a member-at-large was H. H. Morgan (Robert C. Hunt Co.), a past-president of ASTM.

Mr. Kleinhans, membership secretary, reported that C-24, which was organized in September 1959, now has 79 members made up of companies and individuals. A breakdown revealed that the committee membership consists of 33 producers, 30 consumers and 16 with general interests.

To Manage Hooker Plant

Jay P. Eggert has been appointed works manager of a new multimillion dollar synthetic phenol plant to be constructed near South Shore, Ky., by the Durez Plastics Division of Hooker Chemical Corp. Mr. Eggert, who has been production superintendent, chemicals, at the Durez Division plant in North Tonawanda, N.Y., will work with the Corporate Engineering Department in connection with the designing and construction of the new plant and will assume his active duties as works manager when the plant goes on stream, probably by the end of 1961.

Mr. Eggert is a 1941 graduate of the University of Michigan and holds a B.S. degree in chemical engineering. He began his association with Durez in 1946 in the chemical engineering design group. He then became a foreman in the formaldehyde plant and a supervisor in the phenol plant, returning to the design group where he remained until 1952 when he became production superintendent, chemicals for the company.

Containers Program Set

The 10th Corrugated Containers Conference, sponsored jointly by the Technical Association of the Pulp and Paper Industry, New York, and the Canadian Pulp and Paper Association, Montreal, will be held October 10 through 13 at the Royal York Hotel, Toronto, Ontario. It will be the first such conference held in Canada. R. W. Buttery (Bathurst Containers), is general conference chairman.

The subject of Session I and II will be "Printing on Corrugated Board," and D. M. Davis (Hercules Box) will be moderator. Speakers and their topics will be: G. A. Browne (Permaflex Industries), "Printing Press Rollers Designed for Corrugated Printing"; R. Reid (General Printing Ink), "Printing Inks for Corrugated Board"; H. Devon (Jas. A. Matthews), "Printing Dies for Corrugated Board."

Session III will be on "New Developments in Packaging," and H. J. Ostrowski (Hinde & Dauch) will be moderator. Speakers and their topics will be: A. C. Beardsell, "Corrugated Containers under Refrigeration"; T. C. Kitchell (Union Bag-Camp Paper), "Bulk Packaging"; J. Turk, (Glass Containers Manufacturers Institute) "Dynamic Testing of Corrugated Packages"; and A. C. Smith (Atlantic Refining), "Underwater Beam Strength Tests for Waxed Corrugated Board."

Session IV will be a general session. J. G. Reynolds, (Bathurst Containers) will speak on "The Bathurst Method for Determination of Corrugator Starch Consumption."

Probes Fluorine Uses

Allied Chemical Corp., New York, N.Y., with $40 million invested in fluorine chemistry, has stepped up its research into new uses for fluorine and will look for new markets in packaging, rocket propellant, and electric power production fields. The company's General Chemical Division now sells more than 100 fluorochemical products. Currently the biggest market is the Atomic Energy Commission, which uses uranium hexafluoride as a raw material for enriched uranium.

Aclar, a transparent, colorless plastic film recently introduced by the company, is expected to be used by the military for packaging replacement parts. The film, a fluorohalocarbon, is said to have virtually zero moisture absorption.

To Convert Hydrocarbons

A $50,000,000 program for the construction of plants which would convert hydrocarbons into more than a dozen chemical products was revealed by The Borden Co. and U.S. Rubber Co., both of New York City. The two companies announced that they are forming a jointly-owned chemical company, to be called Monochem, Inc., which would erect a major chemical manufacturing unit using hydrocarbons such as natural gas or low flash point liquid fuel as a starting point for the production of acetylene and vinyl chloride monomer. Present plans call for both companies to erect adjacent individually owned plants which will use the output of the Monochem plant for the manufacture of other chemical products.

The companies disclosed that they have optioned several industrial sites in Louisiana and Texas. Other locations are under consideration.

New Shawinigan Polymer

A new resin polymer with high solvent resistance and a high softening point is announced by Shawinigan Resins Corp., Springfield, Mass. Designated as Resin D-430-B, the product contains hydroxyl groups which produce strong bonds with metal surfaces. It is suggested as an intermediate in the preparation of other useful resins and chemical compounds. In addition to being soluble in only a few selected solvents, the new resin has shown solution and film compatiblity with a variety of resin types including blocked polyisocyanates, phenolic resins, polyvinyl acetals, epoxy resins and melamine resins.

"Couldn't I just say that 'fatty acids won't touch it,' instead of saying "substantially insoluable in aliphatic hydrocarbons?"

Particle Board Meeting

The first semiannual meeting of the National Particle Board Association, at the Brown Palace Hotel, Denver, Colorado, on June 2, was highlighted by development of action programs by the Association Technical Committee. Approved by the board were: finalization of industry commercial standards for particle board, to be established with the Technical Standard Division of the Department of Commerce; development of special standards to cover particle board used for underlayment to be adopted by the industry as quality standards for performance; promotion of a symposium on particle board to be held at the Forest Products Laboratory at Madison, Wisc.

Also approved by the members were industry efforts to bring about reasonable tariffs on imported particle board; as well as development of publicity, and active public relations work with elements of the flooring industry. The appointment of Robert E. Dougherty as executive director of the National Particle Board Association was announced. The next meeting of the association will be at the Shoreham Hotel, Washington, D. C., January 1961.

Lumbermen's Ad Program

The West Coast Lumbermen's Association, Portland, Ore., is using builders' testimonials in its national advertising for the first time in 49 years. Three different ads make up the series, all of which tell the home builder that he can save up to $200 on each house he builds by using Utility grade West Coast lumber properly. The ads also offer a free copy of the booklet, "Where To Use Utility Grade West Coast Lumber," which suggests the areas of use for Utility grade lumber, and features FHA span charts for rafters, ceilings and floor joists. Copies are available from the West Coast Lumbermen's Association, 1410 S.W. Morrison St., Portland, Ore.

Appointed by Carwin

Robert E. Ward has been appointed plant manager of the Carwin Company's plant in North Haven, Conn. A graduate of Williams College. Mr. Ward was previously a production supervisor for General Aniline and Film Corporation in Linden, N. J.

J-M Names Managers

Three new general managers for Johns-Manville operating divisions at Toledo, Chicago and New York will assume immediate management of three industrial products division recently affiliated under the administration of Don L. Hinmon. Mr. Hinmon's appointment to the newly-created office of senior operating vice-president was announced recently.

The three new general managers are: T. H. Eaton, E. H. Wells, and J. B. Jobe. Mr. Eaton, a vice-president of Johns-Manville Fiber Glass Inc., is the new general manager of the Fiber Glass Division at Toledo, Ohio. He joined the Johns-Manville organization in 1934 after graduating in chemistry from Western Maryland College.

Mr. Wells, a vice-president of Johns-Manville Dutch Brand Products Corp., has been appointed general manager of the J-M Dutch Brand Division at Chicago. A graduate of the Massachusetts Institute of Technology, he has been with the Johns-Manville organization since 1928, and was elected a vice-president of Johns-Manville Sales Corp. in 1956.

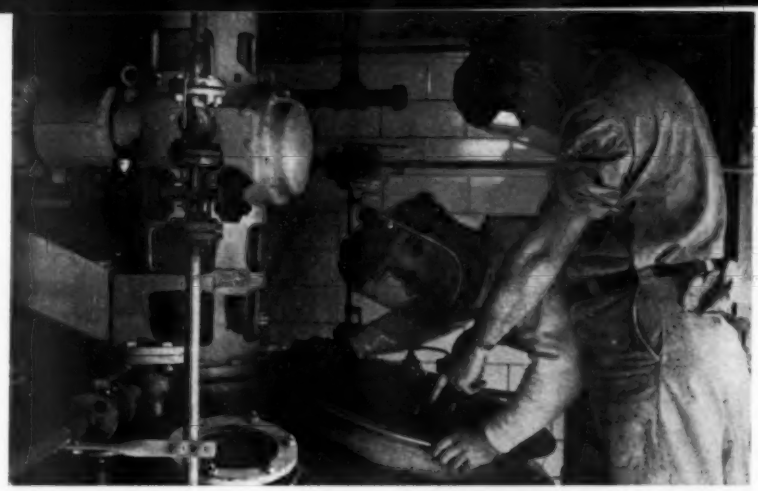
Mr. Jobe has been named general manager of the Industrial Insulations Division, the post formerly held by Mr. Hinmon. He has been elected a vice-president of the Johns-Manville Products Corp. and will also continue as a vice-president of the Johns-Manville Sales Corp. An engineering graduate of Iowa State University, he joined Johns-Manville in 1936.

To National Carbon Post

Fred B. O'Mara has been named vice-president, production, of National Carbon Co., and will continue to be located at the Union Carbide division's production headquarters in Cleveland, Ohio. He has been director of manufacturing for National Carbon since early this year. Mr. O'Mara has been associated with Union Carbide since 1936.

Name Change Announced

Plastic Welding Corp., Newark, N. J., has changed its name to Weldotron Corp. The company is now operating out of two plants and is in the process of expanding its facilities and lines of equipment.



Checking one of the stainless steel reaction tanks in the A. E. Staley Manufacturing Co.'s new pilot plant for modified starch products are Donald Rogers (left), and Supervisor Russell Wilber.

Staley Constructs Pilot Plant

The A. E. Staley Manufacturing Co., Decatur, Ill., has put into operation a new pilot plant designed to speed development of modified starch products for the paper, textile and other industries. A miniature starch processing plant built to scale, of full-size production equipment, with a capacity of up to 12,000 pounds daily, the new pilot facility develops process data on research laboratory findings and produces semi-commercial quantities of new starch products for market development use.

ASTM Fetes Markwardt

L. J. Markwardt, consultant, and retired assistant director, U. S. Forest Products Laboratory, Madison, Wisc., was honored at the 63rd Annual Meeting of the American Society for Testing Materials on June 28 at Atlantic City, N.J. He was presented with a certificate of his election to honorary membership at the Society's national President's Luncheon at Chalfonte-Haddon Hall. (Mr. Markwardt is the author of "Standards for Better Wood Bonding," an article which appeared in the July 1960 issue of ADHESIVES AGE.)

He has served with ASTM since 1920, holding office as president, vice-president, and member of the board of directors, and serving on numerous technical committees. Internationally known as an authority on forest products and their utilization, he is currently chairman of the U.S. Program Committee for technical forest products for the 5th World Forestry Congress to be held in Seattle this year.

Chalkboard Surfacing

A vinyl chalkboard surfacing material, Armorsol, formulated by John L. Armitage and Co., Newark, N.J., is said to eliminate all screech caused by chalk on a blackboard. The baked-on finish, available in blue, green and black, is used by Virginia Metal Products, Inc., on its custom line of movable steel partitions for offices and schools. It is manufactured from vinyl resins produced by Union Carbide Plastics, New York, N.Y.

Corwin Joins FMC

Roger C. Corwin has joined the International Chemical Development and Operations Department of Food Machinery and Chemical Corp., San Jose, Calif., and will be active in the development of foreign subsidiaries and licensees. A chemistry graduate of Williams College, he was formerly in the Commercial Development Department of the Richardson Co., Melrose Park, Ill.

H. E. Robinson

Appointed by Swift

Dr. H. E. Robinson, vice-president in charge of research laboratories, engineering research and equipment development at Swift & Co., Chicago, Ill., has assumed supervision of a number of products-for-industry operations, succeeding E. A. Moss, recently retired vice-president. Swift departments now under Dr. Robinson, in addition to General and Engineering Research, include adhesives, gelatin, stabilizers, soap and chemicals, and the Technical Products Plant, Hammond, Ind.

Dr. Robinson holds degrees from the University of Montana and the University of Pittsburgh, and is a graduate of Harvard University's advanced management program. He joined the Swift research staff in 1932, became assistant director of research in 1941, and assistant director of laboratories in 1950. In 1953 he became director of laboratories, and he was elected vice-president in 1959.

Two Join Hysol Research

Paul E. Doucette and Harry Shwerz have joined the research and development staff of Hysol Corp., Olean, N. Y. Mr. Doucette, now responsible for Hysol's product development program on molding and pelletizing powders, is a graduate of Boston College, Mass., who specialized for the past four years in the application of epoxy resins at Electric Autolite in Toledo, Ohio. Mr. Shwerz, who is currently working on applied research projects, conducted research and development projects at U. S. Vitamin Corp., Yonkers, N. Y., and holds an M.A. in Chemistry from Brooklyn College.

Haveg Appoints Anderson

Thomas F. Anderson has been appointed vice-president of Haveg Industries, Inc., Wilmington, Del. A 1941 graduate of Ohio University, he took post graduate courses at Ohio State University. Mr. Anderson was with Division 8 of the National Defense Research Committee as a research chemist, from 1942 to 1945. From 1945 to 1949 he was with the Plaskon Division of the Libbey-Owens-Ford Glass Co., Toledo, Ohio, as assistant group leader in research. From 1949 to 1952, he was a group leader with the Redstone Arsenal Research Division of Rohm & Haas Co., Huntsville, Ala. He joined Haveg in 1952 as chief chemist, rising to the posts of manager of the New Products Division in 1955, and manager of the Pla-Tank Division in 1956. He was appointed director of research and development in 1958, and manager of the Research and New Products Division in 1960.

Celanese Corp. to Expand

Celanese Corp. of America, New York, N.Y., has announced that it will expand facilities for production of higher acrylate esters at its plant in Pampa, Tex. The planned facilities will have a capacity for producing more than 14 million pounds of 2-ethylhexyl acrylate, butyl acrylate and glacial acrylic acid annually. The expansion is due to be completed before the end of the year, doubling the over-all capacity for acrylate production at the Pampa plant.

Named Senior Officer

Don L. Hinmon has been appointed senior operating vice-president of the Johns-Manville Corp., New York, N. Y. He will be responsible for the J-M Fiber Glass Division, the J-M Industrial Insulation Division, and the J-M Dutch Brand Division. Each division will be directed by its own general manager who will report to Mr. Hinmon.

Eastman Names Agent

American Sealants Co., Hartford, Conn., has been appointed distributor of Eastman 910 Adhesive by Eastman Chemical Products Inc., Kingsport, Tenn. The new adhesive is said to form high-strength bonds with almost any kind of material in seconds or minutes, and to require no heat, pressure or catalyst.

Richard J. Pearson

Sparks Avery Shift

Richard J. Pearson has joined Avery Label Co., Monrovia, Calif., as the major appointee in a reorganization of the company's marketing activity. Under the realignment three Avery men will have new titles and report to Mr. Pearson. They are: M. A. Contreras, *field sales manager*; R. W. Morris, *market development manager*; and W. G. Proper, *custom service manager*.

Mr. Pearson formerly held marketing management positions at Bireley's Division of General Foods Corp., a soft drink firm.

Borden Adds Laboratory

A product development laboratory and a 10 million pound per year dry adhesives plant will be built in Springfield, Ore., by the Borden Chemical Co., New York, N.Y. The company is also expanding existing thermosetting resin and formaldehyde capacity at the Springfield location. Total cost of the project is more than $1 million.

U. S. Shoe Diversifies

United States Shoe Corp. is diversifying, and will become a producer of adhesives and related products. About $250,000 will be spent on the project, and the firm has already leased a plant and storage space comprising more than 15,000 feet in area. Production is scheduled to begin in three to six months. According to Joseph S. Stern, Sr., chairman, the company will use about 15 per cent of its adhesive production and sell the rest. A volume of $1.5 million annually is expected for the plant after the first five years.

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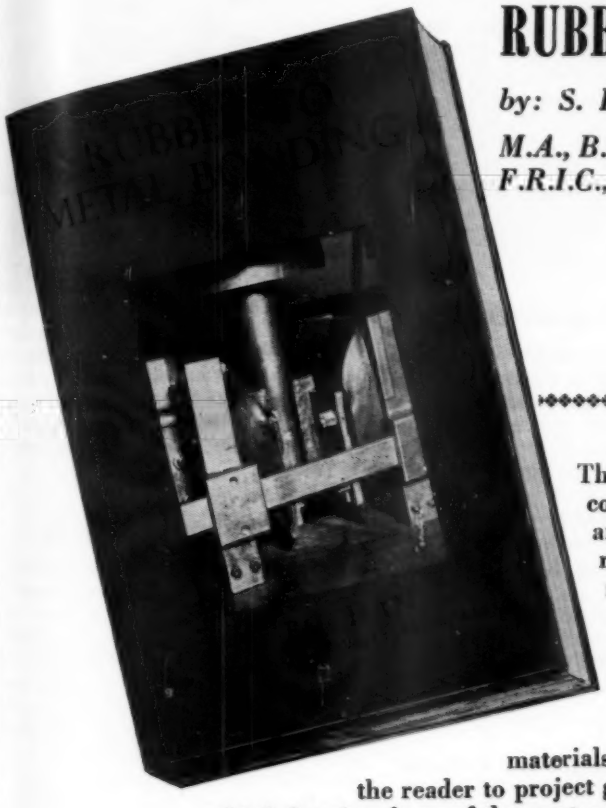

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Celanese Reorganization

A reorganization of certain divisional operations and the appointments of John W. Brooks and Richard W. KixMiller as new executive vice-presidents has been announced by the Celanese Corp. of America, New York, N. Y. Under the reorganization, two new companies, the Celanese Plastic Products Co., and the Celanese Polychem Co., will be added to the existing Celanese Fibers Co., and the Celanese Chemical Co. The two new companies supersede the former Plastics Division.

Mr. Brooks has been assigned directional responsibility over the Fibers and Plastics Products companies; Mr. KixMiller, over the Chemical and Polychem companies. Both officials were previously corporate vice-presidents, with Mr. Brooks in charge of the Fibers Division, and Mr. KixMiller in charge of the Chemical and Plastics Divisions.

New operating heads of the four divisions are Peter H. Conze, president of the Celanese Fibers Co.; William P. Orr, president of the Celanese Polychem Co.; David Taylor, president of the Celanese Plastic Products Co.; and James H. Worth, president of Celanese Chemical Co.

Goodrich Names Jordan

George O. Jordan has been named manager of the Los Angeles adhesives plant of B. F. Goodrich Industrial Products Co., Marietta, Ohio. In the new post he will be responsible for the production of latex, plastisol, and adhesive compounds and technical service to West Coast accounts. Mr. Jordan holds a B.S. degree in chemical engineering from Texas Technological College. He joined the B. F. Goodrich Co. in 1942 and during the past six years has been manager of the latex and plastisol laboratories at Akron, Ohio.

Representatve Named

The Chemical Division of General Mills, Kankakee, Ill., has appointed Ronald Sundberg a sales representative responsible for sales of the company's organic chemical specialty products in Indiana and Michigan. Mr. Sundberg, who holds a B.A. in chemistry from Northwestern University, has been associated with Proctor and Gamble and American Mineral Spirits Co.

Socony Division Formed

Socony Mobil Oil Co., New York, N.Y., has organized a new division, Mobil Chemical Co., to engage in a wide range of activity in the petrochemical industry in the United States and overseas. The new division is designed as a flexible organization. Albert L. Nickerson, president of Socony Mobil, said that the new Mobil Chemical Co. could make and sell new products and undertake joint ventures with others. It will be responsible for major petroleum chemicals produced at or near Socony Mobil facilities. Heading the new unit as president will be Paul V. Keyser, Jr., currently a senior vice-president of Socony Mobil.

Carton Volume Down

The dollar volume of folding cartons shipped in April 1960 was 3.6 per cent under that of the same month a year ago, according to an announcement by the Folding Paper Box Association of America. Tonnage declined 3.4 per cent from shipments reported in April 1959. Industry volume for April of this year was estimated at $74.6 million, a decrease of $3.2 million from the same month last year. Shipments in April totaled 187,200 tons, off 6600 tons from the 193,800 tons shipped in April of 1959.

To Distribute for Carwin

The H. I. Thompson Fiber Glass Co., Los Angeles, Calif, has been appointed distributor in eleven Western states for the infusible urethane foam systems and certain urethane coatings produced by the Carwin Co., North Haven, Conn.

"Yes, I heard the silly ridiculous rumor that we're not buying any more of your company's adhesives. I started it."

Ted Patlovich

Named Representative

Ted Patlovich has been appointed a representative by American Sealants Co., Hartford, Conn. He will cover the New Jersey, Eastern Pennsylvania, Delaware and Maryland area. He is a 1950 graduate of Springfield College, Springfield, Mass.

Soft Seam Foam Bond

Rubbafoam, an adhesive which is said to give a soft seam bond to polyurethane foam and foam rubber, has been announced by Rubba, Incorporated, New York, N. Y. The product is said to dry rapidly, leaving no depression tack. It is applied by brush or machine and will adhere foam rubber, polyurethane foam, vinyl foam and polyether foam to themselves or each other, as well as to leather, wood, fabric, leatherette and other porous materials. It reportedly is fast-grabbing and leaves an almost invisible glue line.

Roberts Changes Label

The Roberts Co., City of Industry, Calif., has changed the label design of its entire new line of Anchor-Weld and Safe-T-Weld contact adhesives and solvents. Company officials said the change was made to incorporate a "family of design" between the contact cements, solvents, and other Roberts products.

National Unit Renamed

Polimeros S. A. in Mexico, an international unit of National Starch & Chemical Corp., New York, N. Y., has changed its corporate name to National Starch & Chemical de Mexico, SA de CV.

Koppers Staff Changes

Announcements of research staff additions and changes have been made by the Koppers Co., Inc., Pittsburgh, Penna., in anticipation of the opening of the company's new Monroeville Laboratory Center and continuation of the Verona Center for chemical engineering and other activities.

Dr. E. W. Volkmann will be manager of the Monroeville Center and Dr. F. L. Jones, manager of the Verona Center. Dr. W. Conard Fernelius, former head of the Chemistry Department at Pennsylvania State University, has joined Koppers as associate director of research. Dr. E. M. Fettes, until recently director of research and development for the Chemical Division of Thiokol Chemical Corp., has joined Koppers as manager, Plastics Section, Research Department. Dr. E. E. Donath has been named manager of contract research; Dr. C. F. Winans has been appointed European representative, and Dr. R. B. Spooner, manager of associated researches.

Cycleweld Names Smith

John P. Smith has been named sales manager, adhesives and sealers, of Cycleweld Chemical Products Division of Chrysler Corp., Detroit, Mich. With Chrysler for 21 years, Mr. Smith became director of parts and service sales for the Chrysler Division in 1955, assistant zone manager in Cleveland of the MoPar Division in 1956, and area sales manager in New York City in 1957. During the past year he has been in Detroit, serving as assistant national retail sales manager for the Service Parts and Accessory Division.

New Eastman Building

Construction has started in Kingsport, Tenn., of new quarters for the sales service and product development laboratories of the Chemicals Division of Eastern Chemical Products, Inc., New York, N.Y. Completion is scheduled for early 1961. The new laboratory building will consist of a basement and two floors totaling 60,000 square feet. When the new building is occupied, the Chemicals Division laboratories will encompass plastics, protective coatings, anti-oxidants, functional fluids, and low molecular weight polyolefins among other groups.

Going Up

Victor Gelb, sales manager of Woodhill Chemical Co., Cleveland, Ohio, is suspended in mid-air by the company's new Duro-Plastic E-Pox-E glue, which can also be used to bond metal, pottery, fiberglass, masonry, wood, glass, porcelain and most plastics. Mr. Gelb recently returned from a European trip to establish foreign distributorships. He has predicted 1960 sales will rise 25 per cent above last year's sales of nearly $2 million.

New Stein, Hall Reps

Otis Langley, Jr., and Keith Miller have been appointed adhesive sales representatives in the South and Mid-West for Stein, Hall & Co., Inc., New York, N.Y. Mr. Langley will specialize in the sale of various types of resin, latex and modified starch adhesives particularly emphasizing the needs of the paper bag manufacturers. His territory will include Georgia, Alabama, Mississippi, Louisiana, Arkansas and Florida. Mr. Miller will be assigned to the company's St. Louis Branch Sales Office.

McKesson Branch Opens

McKesson & Robbins, Inc., New York, N.Y., has opened a new chemical branch in Duluth, Minn. Sales office and warehouse facilities are located at 824-832 W. Railroad St., and the unit's chemical distribution operations will be managed by Richard A. Wagner, formerly a salesman with the company's Minneapolis branch.

Compromise on Casein

A congressional compromise on restoring tariffs on edible forms of casein while continuing the suspension of the duties on the industrial type material has been accepted by the senate. It now remains only for the house to adopt the compromise to send the bill, HR 9862, to the White House for the president's signature.

As reported back by the conference committee, the bill provides that the import duty of 2¾ cents a pound will be levied on imports of sodium caseinate, sodium phosphocaseinate or other caseinates of which casein or lactarine is the component material of chief value. The duty will begin to operate thirty days after the bill is signed.

West Coast Builds Plant

West Coast Adhesives, Portland, Ore., a new manufacturer of adhesives, has completed construction of its manufacturing and testing facilities and is now in operation. Types of adhesives will include all recommended varieties used in manufacturing plywood and doors, including blood and soya for interior and exterior grade plywood, phenolic resin and urea. Glues produced are for both hot press and cold press methods. The new company specializes in glue formulas tailored to specific timber and mill conditions of individual plywood manufacturers.

Electroplating Brightener

A vegetable gum in dry powder form derived from okra is available in semi-commercial quantities, according to the John A. Manning Paper Co., Inc., Troy, N. Y., developer of the material in conjunction with Arthur D. Little, Inc., Cambridge, Mass. Added in small quantities to an electro-plating bath, the gum is said to be particularly effective in providing a brightening action. Morningstar-Paisley, Inc., New York, N. Y., has been named exclusive distributor.

Elected at Pantasote

Charles A. Wyman, a former vice-president, has been elected chairman of the board, and Ralph M. Wyman, a director, of the Pantasote Co., Passaic, N.J. The company is a manufacturer of vinyl film and polyvinyl chloride resin.

Clean Surface Blast Grit

Free sample kits of Black Beauty Blast Grit, a blasting material which leaves a cleaner surface for a better bond and is recommended by the manufacturer for sandblasting of vats, castings, ships, tanks, buildings, stainless steel and non-ferrous metals, are available from H. B. Reed & Co., 6937 Kennedy Ave., Hammond, Ind., or 91 Passaic St., Passaic, N.J. The kits contain from five to eight different grades for varying degrees of etch. According to the company, Black Beauty will not clog or foul machines, it is moisture-free, completely inert, reusable, and longer lasting. Type of work or finish, or degree of etch desired should be specified when requesting information from the company.

New Weyerhaeuser Plant

Weyerhaeuser Co. has started construction on an end-gluing plant at Snoqualmie Falls, Wash. Production is expected to start in September. The plant will produce Nu-Loc.

National to Split Stock

At the annual meeting of the stockholders of National Starch and Chemical Co., New York, N.Y., a two-for-one stock split was authorized. The par value of the common stock will be reduced from $1.00 to 50¢ a share, and the number of authorized shares will be increased to 4 million. Net sales for 1959 were reported at $52,768,725, as compared to $46,200,145 for 1958, and net income was $3,337,150, compared to $3,130,667 for the previous year.

Slates Monomer Unit

Reichhold Chemicals, Inc., White Plains, N.Y., will produce vinyl acetate monomer under a license agreement with Wacker Chemie G.M.B.H., Munich, Germany, the company has announced, and will build a new plant for the purpose. The unit will have an initial capacity of 50 million pounds with planned expansion capacity of 100 million pounds annually. A site has not been selected.

Paterson Overlay Papers

Four new overlay papers, recommended by the company for applications involving high pressure decorative laminates, have been introduced by the Custom Made Paper Department of the Paterson Parchment Paper Co., Bristol, Penna. Each of the papers features a different texture to fit various applications. The papers are available in sheets and rolls up to 84 inches wide. Code XL1470 may also be used as an embedment in plastic products. When used as a vehicle for applying printing or designs to plastic, Code XL1470 becomes transparent, leaving only the printed image. A similar process is followed in applying code 572, which is lighter weight, to various types of plastic sheeting. This overlay sheet can be printed, then incorporated into the plastic thus becoming translucent while the printing remains visible. Code 529 can be used similarly. Also offered is Code XL1469.

ASTM Gypsum Group

A proposed specification for joint tape and adhesives was reviewed at a recent meeting of Committee C-11 on Gypsum of the American Society for Testing Materials. Final action is expected at a future meeting. Another accessory, nails for use with gypsum wall board, has been covered by ASTM Specification C 380. Further revisions to this specification were approved, subject to committee letter ballot. In order to facilitate the use of the ASTM Methods of Tests for Gypsum and Gypsum Products, Committee C-26 will separate the methods into three standards covering chemical analysis, physical tests, and general tests.

Flintkote to Expand

The Flintkote Co., New York, NY. has announced acquisition of a British company and plans to build a plant in Vancouver, B.C., Canada. The company's wholly owned British subsidiary, the Flintkote Co., Ltd., has acquired Enfield Chemicals, Ltd., Accrington, Lancashire, England, for an undisclosed sum. Enfield makes shellac and cellulose finishes, aluminum water and enamel-based paints, and other related products. Flintkote's new plant will manufacture a complete line of resin-asbestos and vinyl floor tile, and will be built under the supervision of the Flintkote Co. of Canada, Ltd.

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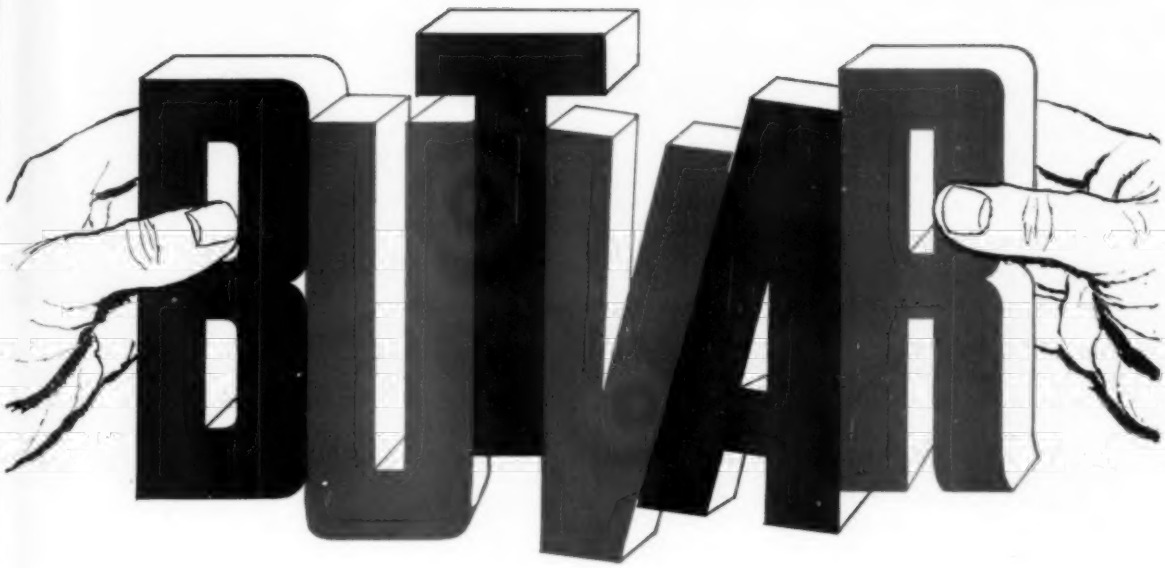


for better adhesion to difficult surfaces

BUTVAR (polyvinyl butyral) resin adds real muscle to adhesive formulations—particularly those to be used for such difficult-to-bond surfaces as metals, plastic films, and other non-porous surfaces.

As a class, BUTVAR resins possess unusual toughness, tensile strength, abrasion resistance and flexibility. In addition, the resins promote exceptionally strong adhesion because they contain three different functional groups in the molecular chain. When combined with thermosetting resins, BUTVAR resins produce structural adhesives having outstanding shear, peel, and creep properties.

The unique combination of physical and chemical properties of BUTVAR resins plus ease of compounding in hot melt and solvent systems make possible a wide variety of adhesives for demanding applications.

A number of BUTVAR resins, varying in molecular weight and chemical composition, are available for your evaluation. Why not test them in your formulations. For complete details, write Shawinigan Resins Corporation, Department 9-J, Springfield 1, Mass. And remember, Shawinigan is your best single source for adhesive raw materials.

SALES OFFICES: ATLANTA CHICAGO LOS ANGELES
NEW YORK SAN FRANCISCO

GELVA,® GELVATOL,® BUTVAR® and FORMVAR®
emulsions and resins for adhesives by

SHAWINIGAN RESINS®

names in the news

J. D. Richards has been named manager of the Seattle plant and Pacific Northwest Sales Division of Bemis Bro. Bag Co., located in Vancouver, Wash., and **E. G. Muir** has been transferred to Seattle as assistant manager.

Dr. Donald A. M. Mackay has been appointed director of research of Evans Research and Development Corp., New York, N.Y., and will direct and coordinate the technical activities of the Research Section.

Carl E. Drugge has been named works manager of the Compton, Calif. plant of the Borden Chemical Co. and will have responsibility for all phases of local production engineering.

Richmond M. Stampley has been named sales manager of the West End Chemicals Division of Stauffer Chemical Co. in San Francisco.

John P. Franze, formerly an instructor at the Michigan College of Mining & Technology, has been appointed a chemist at the Research and Development Center of Armstrong Cork Co., Lancaster, Penna.

J. Dean Hansen has joined the laboratory staff of the Niagara Chemical Division of Food Machinery & Chemical Corp., in Jackson, Miss.

Milton O. Schur has been named vice-president of research of the Packaging Division of Olin Mathieson Chemical Corp., New York, N.Y., and will co-ordinate activities as well as acting in a consultant capacity.

John L. Burton has been elevated to the post of supervisor of Technical Service at the Toronto, Canada office of National Starch and Chemical Co., New York, N.Y.

Robert Wier III, formerly a senior buyer, has been named assistant director of purchases for Hercules Powder Co., Wilmington, Del.

Charles C. Hornbostel, corporate controller of Hooker Chemical Corp., New York, N Y., since he joined the company early last fall, has been elected to the new post of director of finance. **Horace W. Hooker** has been appointed manager of licensing.

Curtiss S. McCune has been appointed division purchasing agent for the Purchasing Department of Hercules Powder Co., Wilmington, Del.

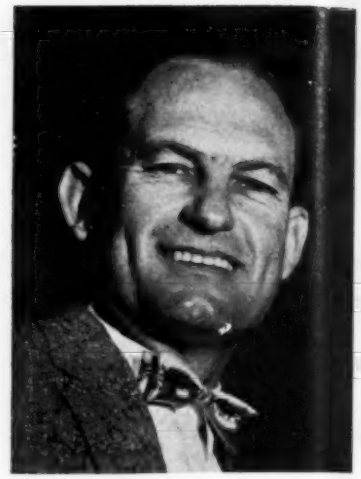
G. K. Wright has been named general manager of B.A.-Shawinigan, Ltd., affiliate of Shawinigan Chemicals, Ltd., Montreal, Quebec, Canada, succeeding **R. H. Hall** who was recently appointed assistant to the vice-president of research and development of the affiliate, and elected to the board of directors of the parent company.

Augustine LaTorre, formerly with Dewey & Almy Chemical Division. has been appointed to the research laboratory staff of Polyvinyl Chemicals, Inc., Peabody, Mass.

C. C. Thomas, Jr., formerly with Westinghouse, has joined Quantum, Inc., Wallingford, Conn. as a project leader.

3M Names Selden

Joseph W. Selden has been elected vice-president for the Chemical Division of Minnesota Mining and Manufacturing Co., St. Paul, Minn. He has been general manager of the Division since 1959. Mr. Selden attended Wayne University. Upon graduating from Pennsylvania State University with a B.S. degree in 1938, he joined Goodyear Tire & Rubber Co., Akron, Ohio. He joined the New Products Division of Minnesota Mining and was manager of that Division from 1953 to 1955. He was assistant general manager of the Chemical Division from 1955 to 1959.



Duke Withrow

Named by Coast Pro-Seal

Duke Withrow has been appointed sales manager for the Chemical Division of Coast Pro-Seal & Manufacturing Co., Los Angeles, Calif. He was formerly products manager of the Electronic Division. He has also been associated with North American Aircraft, Inglewood, Calif., and the Chemical Division of American Latex Products, Hawthorne, Calif.

Armour-Bezons Founded

Armour and Company, Chicago, Ill., and Societe de Produits Chimiques de Synthese, Bezons, France, have completed agreements to establish a new chemical company in France. Owned jointly by the two companies, it will be called Societe Chimique Armour-Bezons. The agreements provide for the construction of a plant in France and for the manufacture of nitrogen derivatives of fatty acids under Armour's patents and technical direction. The derivatives will be sold in Europe and Africa. H. du Manoir has been named president of Armour-Bezons.

Install Automation

Extensive new facilities for automatically applying adhesive backing to rubber, synthetics, cork, fiber, polyurethane and other non-metallics was recently installed at Mechanical Rubber Co., Warwick, N.Y. Designed and built by company personnel, the equipment was engineered for compatibility with Mechanical Rubber's existing production, moulding and extruding.

Executive Office:
120 WALL STREET
NEW YORK 5, N. Y.

Holloway
SUCRO – CHEMICALS CORP.

Reply to:
57-02 48th STREET
MASPETH 78, QUEENS, N. Y.
Telephone: STillwell 4-1712

SUGAR PRODUCTS, SUCRO-CHEMICALS, AGRICULTURAL STICKERS, SUCRO-RESINS AND ADHESIVE CHEMICALS

Laboratory Report on: HOLLESTERS

Subject: The use of HOLLESTERS in polyvinyl alcohol and polyvinyl acetate compounds.

Applications: Adhesives, coatings, binders, moisture barriers, wet strength paper, and heat set printing inks.

Comment—

POLYVINYL ALCOHOL (PVA) FILMS

We have developed several new, economically priced products that have proved to be most interesting when used as an insolubilizer-plasticizers with polyvinyl alcohol and polyvinylacetate.

These products, tradenamed HOLLESTERS, are liquid, modified, stabilized sugar esters and derivatives. They have excellent color and heat stability and are effective in insolubilizing PVA in such compounds as emulsion type paints, coatings and films.

PVA films made with HOLLESTERS have withstood more than 20 minutes in boiling water without any apparent change other than having been softened by the heat. On cooling, the film returned to its original size, clarity and strength.

We have developed several basic formulas for satisfactory films and will be pleased to furnish them on request.

POLYVINYL ACETATE (PVAc) ADHESIVES

Our laboratory has evaluated various combinations of PVAc and HOLLESTERS for adhesive formulations. We have found that 20 parts of PVAc and 2 parts by weight of HOLLESTER ST is a good starting basis for adhesive formulas. This produces excellent adhesive properties and is particularly useful in formulations to be used in instantaneous heat applications.

HOLLOWAY SUCRO-CHEMICALS CORP. does not manufacture adhesives as such, but only chemicals and modifying agents to be used in compounding adhesives for specific applications. If you use adhesives in the manufacture of your products and believe that adhesives containing HOLLESTERS would be useful to you, we will be pleased to give you the names of adhesive manufacturers that use HOLLESTERS in their products.

If you make adhesives of the PVAc type, or films or coatings of PVA and would like to try HOLLESTERS, please write or call for samples.

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TRADE MARK

Holloway SUCRO–CHEMICALS CORP.
57-02 44th Street, Maspeth 78, Queens, N.Y.
Phone: STillwell 4-1712

Aug. 1-5. Gordon Research Conferences, Instrumentation, Colby Junior College, New London, N.H.

Aug. 1-5. Gordon Research Conferences, Solid State Studies in Ceramics, Kimball Union Academy, Meriden, N.H.

Aug. 7-13. Columbia University Industrial Research Conference, Arden House, Harriman, N.Y.

Aug. 8-12. Gordon Research Conferences, Chemistry and Physics of Solids, Kimball Union Academy, Meriden, N.H.

Aug. 8-12. Gordon Research Conferences, Organic Coatings, New Hampton School, New Hampton, N.H.

Aug. 14-17. American Society of Mechanical Engineers-American Institute of Chemical Engineers, Joint Heat Transfer Conference and Exhibit, Statler Hilton Hotel, Buffalo, N.Y.

Aug. 15-19. American Management Association, Workshop Seminar on Package Development and Engineering, Colgate University, Hamilton, N.Y.

Aug. 15-25. International Symposium on the Chemistry of Natural Products, Melbourne, Sydney and Canberra, Australia.

Aug. 18-19. Electronic Packaging Symposium, University of Colorado, Boulder, Colo.

Aug. 24-27. Technical Association of the Pulp & Paper Industry, Forest Biology Conference, Seattle, Wash.

Aug. 27-30. National Association of Furniture Manufacturers, 32nd Annual Convention & 6th Annual Supply, Equipment & Fabric Fair, Conrad Hilton Hotel, Chicago, Ill.

Aug. 28-Sept. 6. Third Materials Handling Exhibition, Oslo, Norway.

Aug. 29-Sept. 2. Gordon Research Conferences, Adhesion, New Hampton School, New Hampton, N.H.

Aug. 29-Sept. 2. Gordon Research Conferences, High Temperature Chemistry, Kimball Union Academy, Meriden, N.H.

Aug. 29-Sept. 10. World Forestry Congress, Seattle, Wash.

Sept. 6-9. Canadian Pulp and Paper Association, Technical Section, Summer Meeting, Banff, Alberta, Canada.

Sept. 7-9. American Society of Mechanical Engineers, Instrument and Regulators Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 8-20. International Aviation & Air Industries Exposition, Waldorf-Astoria Hotel, New York, N.Y.

Sept. 10-17. Fifth International Instrument and Measurements Exhibition and Conference, Stockholm, Sweden.

Sept. 11-14. Produce Packaging Exposition, American Hotel, Miami Beach, Fla.

Sept. 12-20. 23rd International Shoe and Leather Exhibition, Vigevano, Italy.

Sept. 13-15. 5th International Instruments and Measurements Conference, Stockholm, Sweden.

Sept. 13-15. American Chemical Society, New York Section, Chemical Exposition, Hotel Statler, New York, N.Y.

Sept. 14. Packaging Institute, Professional Member Seminar on Folding Cartons, Drake Hotel, Chicago, Ill.

Portrait Of

C. A. DAHLQUIST

Carl A. Dahlquist is the supervisor of the Basic Research Group, Tape Research Department, Minnesota Mining and Mfg. Co. He first went to work for 3M in 1943 as a research chemist in the company's Central Research Department. Under the direction of Drs. J. O. Hendricks and H. N. Stephens he began a study of the surface properties of polymers. This work resulted in several patents on release coatings and in publications on the rheology of soft elastomeric materials.

In 1952, Mr. Dahlquist was appointed 3M's first research associate, moving on in 1955 to become a group supervisor in Applied Research. He received his present appointment in 1957.

Though his present duties are largely supervisory, Mr. Dahlquist is still actively engaged in research in rheology and adhesion. He is a member of the American Chemical Society, the Society of Rheology, and the American Society for Testing Materials.

Mr. Dahlquist attended the University of Minnesota from which he received his degree of Bachelor of Chemical Engineering in 1934. He continued in graduate school majoring in chemical engineering, physical chemistry and bacteriology. While doing graduate work he held a research fellowship with Minnesota State Canners' Association and worked on disposal of cannery waste.

IF YOU ARE BONDING...

Decorative Plastic to Decorative Plastic
Decorative Plastic to Neoprene
Decorative Plastic to Rubber
Concrete to Rubber
Fabric to Fabric
Fabric to Metal
Fabric to Paper
Fabric to Plastics
Fabric to Rubber
Fabric to Wood
Formica to Plywood
Glass to Decorative Plastic
Glass to Ceramics
Glass to Fabric
Glass to Formica
Glass to Glass
Glass to Metal
Glass to Paper
Glass to Plastics
Glass to Rubber
Glass to Wood
Leather to Leather
Leather to Metal
Leather to Rubber
Metal to Ceramics
Metal to Metal
Metal to Plastics
Metal to Rubber
Metal to Wood
Neoprene to Neoprene
Rubber to Rubber
Rubber to Ceramics

A NEOPRENE ADHESIVE IS YOUR ANSWER

Manufacturers are successfully bonding varied surfaces with quality adhesives based on Du Pont neoprene synthetic rubber. Here are some of their reasons:

Neoprene adhesives are compatible with a wide range of materials—Because neoprene is an elastomer, its adhesive bonds are flexible. On materials like fabric and leather, they display outstanding flex life; on rigid surfaces, they withstand impact, have good thermal stability . . . can take almost any form of physical abuse.

Neoprene adhesives offer strong, tough, long-lasting bonds—What's more, neoprene adhesive bonds *stay* strong and tough. They offer unmatched *all-around* resistance to heat, aging, oil, grease, solvents, weathering and chemicals.

Neoprene adhesives are versatile . . . easy to use—A solvent or latex type is available—or can be tailor-made—to meet almost any need, including immediate or delayed bond development and high hot bond strength. In addition, both latex and solvent types have good storage stability and can be easily applied by brush, spray or roller. Contact your adhesives supplier for a specific recommendation for your bonding problem.

Neoprene is backed by 25 years of proven performance as an industrial and automotive adhesive. Special neoprene adhesives are now used by manufacturers of shoes, aircraft, furniture and building materials. Ask your supplier about neoprene adhesives. E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department AA-2, Wilmington 98, Delaware.

DU PONT
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NEOPRENE
FOR ADHESIVES

Better Things for Better Living . . . *through Chemistry*

patent review

By MELVIN NORD

Roll Type Glue Spreaders

U. S. Patent 2,926,628, issued March 1, 1960 to Robert S. Black and James S. Carroll, provides a roll type glue spreader.

In Figure 1 the upper and lower main rolls are shown at 11 and 12, respectively, and the companion doctor rolls are shown at 13 and 14, respectively. The upper main roll is shown schematically as provided with the upwardly extending vertical stem (15) carrying one of the journals for such roll, shown at 16. A

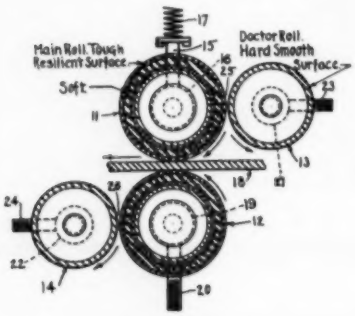


Figure 1

spring (17) urges the stem (15) downwardly to produce a pressure of the upper main roll against the sheet (18) being coated, such sheet travelling towards the left as shown in Figure 1.

The journal (19) is shown for one end of the lower main roll, being connected to the stem (20). By adjusting the stems for the lower roll's journals, the evaluation of such lower roll may be adjusted to meet requirements of various specified thicknesses of sheet stock being fed between the two rolls. To effect such adjustments the lower stem (20) is shown as being threaded to receive an adjusting screw element. The two doctor rolls are shown as provided with journals (21 and 22), each such journal being provided with a corresponding horizontally extending stem (23 or 24).

These stems are shown as being threaded to receive adjusting elements whereby the doctor rolls may be adjusted towards and away from their companion main rolls to adjust the clearances (25 and 26) between such doctor rolls and their companion main rolls. Pockets are thus provided between the doctor and main rolls, so that adhesive or other liquid material to be applied to the surfaces of the sheet (18) may be carried by the main rolls to the sheet areas being treated. The amount or thickness of the film of adhesive planted on the surface of the sheet is adjustable by the setting of the doctor rolls.

Figure 2 shows the detailed construction of one of the main rolls. It comprises the two end blocks (27 and 28) which are provided with the outwardly extending shaft extensions (29 and 30). These shaft extensions are provided with journal receiving sections (31 and 32). Blocks 33 and 34 are secured to the blocks 27 and 28, by seating such blocks onto the inner end portions of the blocks 27 and 28, respectively, and welding the parts together as indicated in Figure 2. The blocks 33 and 34 are shouldered as shown at 35 and 36 to receive the ends of a tube 37 which constitutes the unyieldable element on which the yieldable elements of the roll are mounted.

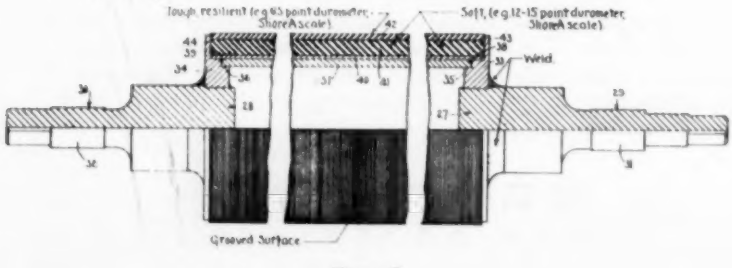


Figure 2

The yieldable section of the roll is tubular in form, comprising the inner thin tubular sheet 40, of metal or hard rubber, on which is directly mounted the cylindrical inner soft resilient yieldable section 41. Onto this soft inner section is mounted the outer harder cylindrical section (42) which is also of yieldable, resilient material, such as rubber or neoprene.

The hardness of the outer section (42) as compared to the inner section (41) is such that when a deforming force has been exerted on the outer surfaces to deform the ridges to any extent, inward pressure is also being developed against the soft inner section (41). Thus this section will also yield inwardly, so that less deformation of the ridges will occur than would be the case with an inner section of material substantially of the same hardness as the outer section. Accordingly, less adhesive will be expelled from the adjacent grooves than would be the case with a harder inner section.

The hardnesses of the two sections can be made in relation to each other so that when a certain pressure or force has been developed against the outer ridge surfaces with corresponding expulsion of desired amount of adhesive, further force developed against such ridges will cause inward deformation of the inner section as fast as the outer surface is forced inward. In this way, a limit is then reached as to the amount of adhesive which may be expelled from the groove. Thus, excessive pressures developed against the surfaces will not thereafter change the amount of adhesive which will be expelled. This function is directly related to the fact that the outer section (42) is formed of much harder yieldable and resilient material than the inner section.

Applying Pressure-Sensitive Adhesive Labels

U. S. Patent 2,920,780, issued Jan. 12, 1960 to William E. Hauschild and John E. Solecki, assigned to Western Electric Co., Inc., provides apparatus for applying pressure-sensitive adhesive labels to cartons.

As shown in Figure 3, the cartons (17) are moved through a vertical path by a conveyor or elevator (25) which includes hangers (26) pivotally mounted on a conveyor chain (27)

engaging drive sprockets (28) which are driven by a suitable drive mechanism indicated diagrammatically at (30). Vertical L-shaped guide members (32) of the conveyor form a vertical guideway for guiding the cartons as they are raised.

A tape dispensing device (35) for applying the labels (15) onto the cartons as they move by has a spool

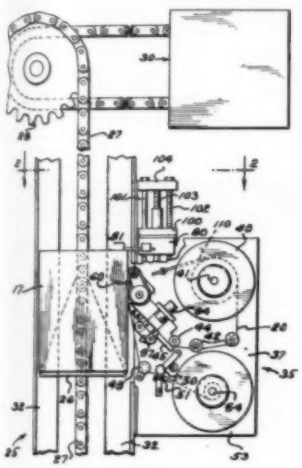


Figure 3

or reel (40) for holding a supply of the tape (20) with the labels on it. The spool is rotatably mounted on a supporting spindle (41) on the frame plate (37) and the tape (20) is guided through a predetermined path around idler rollers (42) and a spring pressed roller (44) which presses the tape against an inclined guide plate (45).

The upper end of the guide plate (45) has a narrow edge forming a relatively sharp corner which is positioned adjacent to the path of travel of the cartons (17), and the tape (20) is moved through a sharp angle around the corner to cause the labels to progressively separate from, or peel off of, the tape and be carried into engagement with the carton (17) positioned in its path of movement. The adhesive side of the label contacts the carton. The end portion of the label adheres to the carton and aids in removing the label from the tape. With the labels removed therefrom, the tape (20) is directed downwardly and laterally around a guide roller (49) and between a pair of meshing spur gears (50 and 51) which grip the tape. As the tape leaves the drive gears (50 and 51), it is wound up on a tape spool or reel (53) releasably mounted on a drive spindle (54).

Pressure-Sensitive Tape

U. S. Patent 2,927,868, issued March 8, 1960 to Harold J. Revoir, assigned to Minnesota Mining & Manufacturing Co., provides an improved pressure-sensitive adhesive tape.

The backing consists, as usual, of a non-fibrous cellulose acetate film. The coating consists, as usual, of a water-insoluble rubbery-base adhesive which is normally and aggressively tacky.

The improvement consists of interposing a primer film coating of extreme thinness between the backing and the adhesive, which unites the adhesive to the backing film much more tightly than usual. Its purpose is to assure retention of the integrity of the tape when unwound from the roll and when removed from smooth surfaces (such as glass or metal).

The primer film consists of a mixture of latex rubber, casein, and polyvinylpyrrolidone.

Production of High Wet-Strength Paper

U. S. Patent 2,928,736, issued March 15, 1960 to Thomas M. Laakso and William F. Fowler, Jr., assigned to Eastman Kodak Co., describes a method for imparting high wet strength to photographic paper.

A polyaminotriazole-formaldehyde intermediate resin condensate is added to the paper pulp for this purpose. These resin intermediates are most effective when used in the presence of aluminum chloride.

Bonding Textiles to Rubber

U. S. Patent 2,927,051, issued March 1, 1960 to Howard M. Buckwalter and Joseph M. Almand, assigned to United States Rubber Co., relates to compositions for adhering textiles to rubber. The adhesive is formed in place by heating resorcinol and the reaction product of 1,3-diaryl guanidine and formaldehyde.

Other Patents of Interest

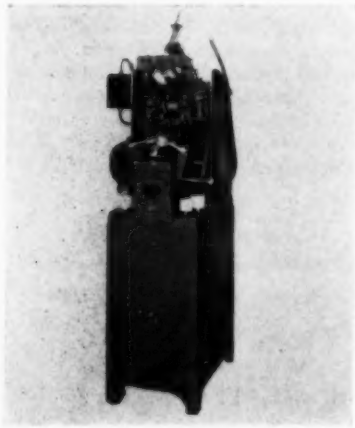
Subject	Inventor or Assignee	Patent No.	Date
Ready-made bandage	Willard W. Look, Jr.	2,927,689	3/8/60
Tape dispenser	Anna S. Raber	2,927,710	3/8/60
Organosiloxane - phenol - aldehyde resin cements	The Dow Chemical Co.	2,927,910	3/8/60
Preparation of casein with low viscosity and high adhesive strength	National Dairy Products Corp.	2,927,916	3/8/60
Sterilization of gums	Johnson & Johnson	2,928,717	3/15/60
Preparation of propionamide ethers of starch	Corn Products Co.	2,928,827	3/15/60
Casein paster gate	American Machines & Foundry Co.	2,929,352	3/22/60
Adhesive applying apparatus	United Shoe Machinery Corp.	2,929,353	3/22/60
Method of hardening shellac and gum arabic	Universal Match Corp.	2,929,732	3/22/60
Manufacture of heat stabilizing and plasticizing paste compositions	National Lead Co.	2,929,733	3/22/60
Production of starch grits	A. E. Staley Mfg. Co.	2,929,748	3/22/60
Starch products of stable viscosity	Secretary of Agriculture	2,929,811	3/22/60
Butadiene - styrene - albumin adhesive composition	Armstrong Cork Co.	2,930,728	3/29/60
Adhesive ingredient containing Douglas-fir bark material	American-Marietta Co.	2,920,772	3/29/60

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

new equipment

High Speed Labelers

Produced in conventional adhesive and heat seal models, the Autorex Precision Labeling Machines, developed by Rawsons Ltd., Kent, England, labels glass, metal, plastic, cardboard and fiber containers of regular or irregular shape. Able to



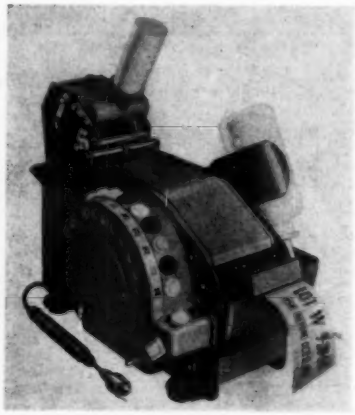
apply from 1,200 to 2,000 labels per hour, depending on container size, the machines also label a variety of products including tool handles, ampules, collapsible tubes, paper packets and aerosols. The U.S. distributor reports that these compact machines are particularly adaptable to irregularly shaped, normally difficult to label containers and products. Easily integrated into existing packaging operations, the machines, though self-powered, may be readily adjusted to existing product output. Labels are applied in either of two interchangeable wiping movements —side wiping on round and rectangular container, and press wiping on panel or irregularly shaped bottles or products. Range of label sizes are variable from ½ inch to 4⅞ inches in height and from ½ inch to 4½ inches in width. Container sizes range from 1 inch to 10 inches in length and from ½ ounce to 20 ounces. Autorex adhesive models are 5 feet in over-all height, 22½ inches deep, 20 inches wide and weigh 250 pounds. *Potdevin Machine Co.* **E-208**

Adhesive Dispensing Tube

The Twelve/1000ths dispensing tube, with a dispensing nozzle that is 12 thousandths of an inch in diameter, can dispense a drop of glue as small as 1½ millimeters in diameter, or a grand total of 38,000 such drops in a standard ½ ounce tube. The manufacturer states that this controlled accuracy makes the tube economical to use, there being no sloppy spillage or waste, especially in tight places where an excess amount of glue would be detrimental to the rest of the product being manufactured. *Bond Adhesive Co.* **E-209**

Electric Code Taper

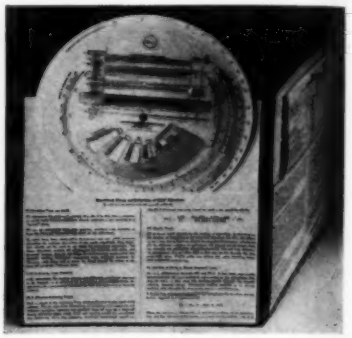
The CodeTaper 555 codes and seals packages in one operation, and is said to eliminate many extra marking, stamping and labeling operations. The electric model measures, feeds, hot-water moistens, cuts and prints tape at the touch of a button. According to the manufacturer, the unit has many applications in production packaging where it is desirable to code or label cartons as



they are being sealed with data such as: contents, production or packing dates, lot number, packer number, etc. The electric tape dispenser contains a self-inking printer, equipped with a throw-away plastic cartridge which is available with a choice of seven colors. *Better Packages, Inc.* **E-210**

Assembly Time Calculator

A slide rule type instrument, the Electro-Mechanical Assembly-Time Calculator (EMAC) is said to automatically estimate the manufacturing time of electronic and electro-mechanical assemblies. In addition to furnishing new manufacturing data, EMAC provides rapid and accurate answers to problems previously requiring hours of hand and mechanical computation, the manufacturing states. The calculator will furnish such answers as: average time to manufacture assemblies in different quantities; savings on repeat runs: efficiency ratings for particular oper-



ators or shops; effect of number of operators on manufacturing time; number of units to be manufactured before reaching standard time; and times for different types of operations. The basic data fed into the calculator is the type and number of operations comprising the complete assembly. *Manufacturing Laboratories.* **E-211**

Epoxy Spray Gun

The Resin Flow Epoxy Spray Gun is designed to spray premixed epoxy resin formulations. It will handle base and formulated resins with a viscosity range of 50 to 5,000 centipoises. The gun features a unique patent pending nozzle which permits the use of expendable cardboard resin container cups. The nozzle is non-clogging, easy to clean and available in several size openings to also permit spraying liquid parting agents. The gun operates at 50 to 60 pounds air pressure and weighs 1½ pounds. The throw-away resin cups will hold 8 ounces to 2 pounds of premixed resin. According to the manufacturer, the uniform spray pattern provides quick impregnation and thorough wet-out. *Plaster Supply House.* **E-212**

Air-Operated "C" Clamps

The manufacturer has designed two types of air-operated "C" clamps —a heavy-duty series for exceptional

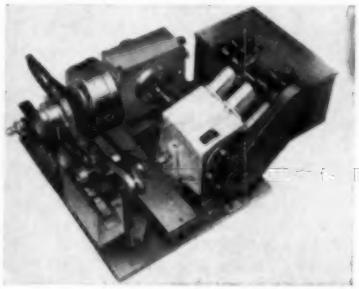
strength and durability, and an economy series for average applications. The clamps are available with a manual sleeve valve or with an integral solenoid valve for automation applications. Various power factors are also available. All clamps are available with a number of optional clamping ends. The clamp in the photograph has a zero to six inch adjustable opening with a depth of 3¼ inches and the cylinder has a 7:1 power factor. Other clamps in the line have maximum openings of 7 inches, 8 inches and 9 inches. *Airmatic Valve, Inc.* **E-213**

Tensile Tester Work Base

The new Xpandable work platform permits the proper set-up for special tests of adhesives, wire, steel, plastics, rubber, springs, etc., by expanding the normal work area almost three times. Portable and easy to install, the work base facilitates almost unlimited tests of tensile, compression, transverse and shear loadings. The photograph shows a complete polarized light set-up for checking plastic specimens in tensile. The tester is 0 to 10,000 pounds capacity. *W. C. Dillon & Co., Inc.* **E-214**

Adhesive Applicator

A new, high-capacity adhesive applicator that is able to glue plain kraft box boards, materials surfaced with foil and polyethylene and a variety of waxed boards, Model BW Thermogrip Applicator applies 1,500 feet of ¼ inch seam or 1,000 feet of continuous ⅜ inch seam per minute. The hot melt adhesive may also be applied in dots or other broken line patterns. According to the manufacturer, quick setting makes the unit ideal for adhesion of heavy seams and for fast running work where high production volume is required. Model BW is designed for use as a



complete adhesive package primarily for straight line gluing operations on both conventional or specially built carton making or gluing machinery. The gluing mechanism may be obtained fitted for mounting in an inverted position or on its side so that materials may be passed against the transfer wheel for gluing from above, below or to a vertical surface. *United Shoe Machinery Corp.* **E-215**

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book reviews

Acrylic Resins. *By Milton B. Horn. Published by Reinhold Publishing Corp., 430 Park Ave., New York 16, N.Y. 4 x 7½ in. 184 pp. $4.50.*

Acrylate monomers and polymers are used for a wide range of adhesive products. Depending on the type and formulation of resin, their adhesion varies from pressure-sensitive to hard fused bonds. Their ability to withstand aging, weather and heat exposure without deterioration makes these products ideal for permanent bonds, while their clarity renders them specific, if the bonded materials are transparent and the adhesive is visible. Since, according to a recent estimate, 60 per cent of all synthetic resin and plastic production in the U.S. is based on this vinyl group of polymers, the current handbook for potential users written by a research director of a major chemical corporation should be highly welcomed by the trade.

Commercially available for about thirty years, acrylics cannot claim to be a new plastic. Large and small manufacturers are turning out basic chemicals and specialty items; all the "Big Four" of the rubber industry, for example, producing lines of rubbers in the acrylonitrile-butadiene polymer area. Nevertheless, a handbook-size collection of recent fabrication data is certain to make this clear, not overly technical text a valuable introduction or reference for businessman and engineer alike. From it, he can learn the entire life story of acrylics, from their obscure laboratory beginnings over 100 years ago to their present variegated applications at a phenomenal consumption rate, totaling 500 million pounds in elastomers alone, during 1958.

Many lengthier and more specialized tomes have been published on the subject, but none quite as comprehensive and concise. Organizing the discussion around four main product categories—cast goods, molding powders, emulsions and solutions—helps the reader find his way through this prolific resin family to identify the substance and process suited to his individual production needs. Application techniques are illustrated in schematic and photographic form. Physical and use data are conveniently summarized in tables. Future trends are forecast in a final chapter, while the appendix supplies a basic reading list.

Adhesive manufacturers are referred to the pages on emulsions and solutions, describing three basic systems to overcome basic bonding problems: air-drying, the hot melt process and utilization of pressure-sensitive types. The author predicts increased interest in alpha-cyanoacrylate, once the price of this high-strength, solventless monomer approaches competitive levels. Such well reasoned opinions, drawn from Mr. Horn's extensive study and familiarity with the field, assure the success of his announced aims—to broaden horizons of the specialist and to give chemists, sales personnel and executives a bird's-eye view of a complex industry.

Developing Executive Skills. *Edited by H. F. Merrill and E. Marting. Published by American Management Association, Inc., 1515 Broadway, New York 36, N.Y. 6 x 9 in. 431 pp. $9.00 (AMA members $6.00).*

The need for basing promotions of executive personnel on objective criteria was recognized quite early in this century, but it remained for World War II, with its unprecedented demands on industry, to bring home the shortage of management manpower. The postwar economic boom placed an even greater premium on qualified persons to fill crucial positions, whether recruited from the ranks of recent graduates or found in the lower echelons of a major concern. However, according to the most recent figures supplied in this authoritative compendium on "management development," five years ago only 54 per cent of presumably progressive firms canvassed in a survey had a formalized program to promote the best men from within, 80 per cent of them having launched it less than ten years before.

That dilemma, as the anthropologists would tell us, is part of a larger "cultural lag," which characterizes the delay between the discovery of a scientific principle and its general adoption. There is certainly no lack of proven techniques in this area of human relations in industry. Nearly forty authors, contributing to the present American Management Association study, describe methods from the most simple elaboration on traditional procedures, such as apprenticeship, to the latest psychological tests dreamed up behind one-way mirrors. Most of the chapters are drawn from company files, a few have been written by professors of business administration.

No matter how strong our nostalgia for the good old days of the self-made man who had merely to prove his mettle to get to the top, we must give the experts their due in this era of satellites and Soviet scientific competition. Our scarcity of technical and executive talent has been documented so much, that the question is no longer *whether* to add science to the art of a personnel director, but how to do it most effectively. As these authors advise us, management skills are not automatically discovered through the varied means they suggest. It takes a lot of trial and error to develop an approach tailored to a particular business and an individual position, keeping in mind that formal training can supplement but never replace on-the-job coaching. The case study orientation of their writing should help companies about to launch into the field over the rough spots, and convince any remaining skeptics that even the smallest firm must modernize its policies to recruit the best men for the right jobs.

Trade Literature

Spray Painting Machine. This new brochure covers a pressure contact spray painting machine that incorporates new features including enlarged plenum chamber, accurate variable speed oscillation, air filter, automatic trap, and adjustable spraying time. Standard models covered have single and double stationary or single and double oscillating guns which may be all air operated or driven by explosion-proof motor and are available with incorporated mask washers. *Conforming Matrix Corp.* *L-252*

Applications Directory. A 121-page booklet, "Where to Use Permacel Products," has listings for every major type of industry and business in the country, showing which Permacel products are used for specific applications in each industry. The recommended products include pressure-sensitive tapes, adhesives, sealants, coatings and electrical insulating materials. *Permacel.* *L-253*

Development of Aliphatic Chemicals. "Progressive Aliphatic Chemistry" is the story of the ten-year development of aliphatic chemicals at the Armour plant in McCook, Ill. The 20-page pamphlet is intended to acquaint readers with plant operations and products and to point out various applications of the products. Plant facilities and some product applications are illustrated. *Armour Industrial Chemical Co.* *L-254*

New Ways of Using Epon Resins. A small handbook, "New Horizons for Epon Resins," discusses novel uses for the industrial plastic. Included are case histories where the resin was utilized in protecting electronic equipment, preventing concrete floor erosion, as a spray mask, in guarding against salt-water corrosion, and in construction of fin tips for jets. *Shell Chemical Co.* *L-255*

TECHNOLOGY OF ADHESIVES AT YOUR FINGERTIPS

SERVICE

Subscribers to ADHESIVES AGE may now obtain, from one central source, technical literature dealing with all aspects of the adhesives industry. One or more of the books listed here may be of invaluable assistance to you. Look this list over and check the books suited to your needs.

- **Adhesive Bonding of Metals—G. Epstein. $2.95.** Considers adhesives used with metals, indicating when an adhesive-bonded joint is advantageous; the type adhesive to use; how to use it, and how to design the joint for optimum performance. ☐

- **Adhesive Bonding of Reinforced Plastics—H. A. Perry. $8.75.** Survey of the design and assembly of structures and products, particularly glass-fiber-reinforced plastic products, by means of adhesives. Gives data on equipment and methods used to produce adhesive bonded joints. ☐

- **Adhesion and Adhesives—N. A. De Bruyne and R. Houwink. $13.50.** A collection of information on the scientific and technological aspects of adhesion. Part I deals with theory, while Part II is devoted to the technology of adhesion. ☐

- **Epoxy Resins—Their Applications and Technology—H. Lee and K. Neville. $8.00.** Guide to the field of epoxy resins, covering the chemistry of their preparation and applications, including a section on adhesives. ☐

- **Polyamide Resins—Donald E. Floyd. $4.50.** Discusses in detail various important applications of the polymers belonging to the polyamide resin family and includes a comprehensive section on adhesives. ☐

- **Principles of High Polymer Theory and Practice—A. X. Schmidt and C. A. Marlies. $13.50.** Study of the principles of high-polymer theory and practice, with a section on adhesives, their applications, and mechanisms and factors involved. ☐

- **Recent Advances in Gelatine and Glue Research—G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Vinyl Resins—Mayo Smith. $5.75.** Surveys applications of vinyl resins with information on their types, properties, chemistry, manufacture and fabrication. Includes information on several types of adhesives in this category. ☐

- **Epoxy Resins—Irving Skeist. $5.50.** A chapter on adhesives is included in this complete study of the entire field of epoxy resins. The author gives formulations, trade names, methods of manufacture and applications. ☐

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Uses of Neoprene and Hypalon. "Elastomers Notebook," Du Pont periodical, has stressed increased use of these two synthetic rubbers. This bimonthly publication features case histories in the architectural field. Applications are usually illustrated and diagrammed. Past issues have dealt with such topics as: portable structures made from neoprene and Hypalon coated fabrics, neoprene glazing strips and curtain wall sealing gaskets, weather-resistant neoprene expansion joints, neoprene based floor coverings, Hypalon exterior coating, neoprene beam bearing pads, and neoprene sealed fasteners. *E. I. du Pont de Nemours & Co.* **L-256**

Miniaturized Electric-Eye Applications. This 16-page booklet, "ESS Miniaturized Electric Eyes," Bulletin No. 571, covers in detail applications for counting, sorting, monitoring, assembling and automatic weighing as applied to packaging, printing and general production. Equipment described ranges from direct or partial cut-off to reflector type units, and an expanded section covers specific in-plant installations. Technical and specification data includes dimensions, circuitry, speed, monitoring and relays. *Photomation, Inc.* **L-257**

Viscosity Stabilizer. An improved viscosity stabilizer that reduces the "free water" in paste formulas for corrugated box manufacturing is described in this product-information bulletin. The technical report on the material, called No. 822 Viscosity Stabilizer, also includes field tested formulas using No. 822 with corn starch and tapioca flour in a standard 333 gallon mix for single systems; double system, single facer; and double system, double backer. *Morningstar-Paisley, Inc.* **L-258**

Laboratory Ware. Catalog No. H-459 contains 24 pages which cover polyethylene, polyproplylene, polyurethane and polyvinyl plastic laboratory apparatus. Over 100 products are illustrated and described and technical properties are discussed in their relation to resistance to chemical attack. *General Scientific Equipment Co.* **L-259**

Polysulfide Base Compounds. This four-page folder describes sealing of joints with polysulfide sealants. Such applications as use in swimming pools and in sealing joints are covered, with accompanying photos and diagrams showing how the sealant is applied. *Thiokol Chemical Corp.* **L-260**

Adhesives, Coatings and Sealers. A 12-page illustrated catalog, "Adhesive Products for the Construction Trades," contains applications and properties information on a complete line of adhesives, coatings and sealers for residential, commercial, industrial and institutional building construction. Included in the catalog are adhesives for installing ceramic wall and floor tile, insulation, decorative laminates, hardboard or wallboard, gypsum drywall, vinyl and rubber floor tile, cover bases, wood block flooring and carpet tack strips. *Adhesives and Coatings Division, Minnesota Mining and Manufacturing Co.* **L-261**

Resin Adhesives. This comprehensive booklet contains information on the properties, uses and methods of application in the plywood and wood-working industries of such resin adhesives as Urac, Melurac and Cymel. These materials are essentially urea-formaldehyde, melamine-urea formaldehyde, and straight melamine resins. Described in detail are Urac 180, 185, 186 and 110; Medurac 255, 260, 300 302 and 305; and Cymel 401. In addition, the company's wood-particle binder resin are described. *American Cyanamid Co.* **L-262**

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in passing

Ain't It the Truth

E. B. Terhune, Jr., publisher of *Boot and Shoe Recorder*, asks if you've ever noticed that:

"When the other fellow takes a long time, he's slow. But when you take a long time, you're thorough.

"When the other fellow doesn't send his reports in, he's lazy. But when you don't do it, you're too busy.

"When the other fellow does something without being told, he's overstepping his bounds. But when you do something without being told, that's initiative.

"When the other fellow sells with a hard-sell pitch, he's using high pressure. But when you do it, you're being firm.

"When the other fellow pleases the boss, he's polishing the brass. But when you please the boss, that's cooperation.

"When the other fellow overlooks a rule of etiquette, he's rude. But when you skip a few rules, you're original.

"When the other fellow gets ahead, he's getting breaks. But when you manage to get ahead, it's hard work."

Temperate August

The month of August, probably influenced by vacation time, presents us with a bare minimum of observances. These are: 1-7, National Clown Week and International Printing Week; 1-31, National Sandwich Month; 8, International Character Day; and 21, Quarterly Temperance Sunday.

"Waisted" Keys

A Chicago manufacturer of men's belts has come up with an innovation which might end the stress caused by lost car keys. They have styled their latest model belts with a duplicate car key forming the tongue of the belt. They don't say how your pants stay up while you use the extra key.

Tippler Tether

John Lichty, who maintains an establishment of relaxation and refreshment in Lander, Wy., has installed safety belts along his bar. He fastens them around customers who show signs of unsteadiness on the stools.

Excuses and Results

(1) "That's the way we've always done it."
(2) "I didn't know you were in a hurry for it."
(3) "That's not in my department."
(4) "No one told me to go ahead."
(5) "I'm waiting for an OK."
(6) "How did I know this was different."
(7) "That's his job. Not mine."
(8) "Wait 'till the boss comes back and ask him."
(9) "I forgot."
(10) "I didn't think it was very important."
(11) "I'm so busy I just couldn't get around to it."
(12) "I thought I told you."
(13) "I wasn't hired to do that."
(14) "To the devil with it."

Government and You

What it costs you, the taxpayer, for various government services and agencies is shown below in figures compiled by Gates Rubber Co., based on the amount paid by a married couple with taxable income of $6,000. Federal income tax alone on this are $1,240.

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Farm price supports	58
Foreign aid	53
Aids for aviaton, space exploration, housing, education	44
Atomic energy	40
Relief	31
Conservation	28
Public Health	12
Total	$1,240

No Laggard He

Printers' Ink reports that when *Time Magazine* conjectured in its May 9 issue that *The Detroit Times* was for sale, *Times* publisher Phil deBeaubien—an old promotional hand—put the rumor to work. In a letter to Detroiters, deBeaubien wrote: "The report is correct, *The Detroit Times* is for sale. The price is eight cents daily and 20 cents Sunday."